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Stacking and metamorphism of continuous segments of subducted lithosphere in a high-pressure wedge: The example of Alpine Corsica (France)

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Abstract

Alpine Corsica consists of a stack of variably metamorphosed units of continental and Tethys-derived rocks. It represents an excellent example of high-pressure (H*P*) orogenic belt, such as the Western Alps, exposed over a small and accessible area. Compared to the Western Alps, the geology of Alpine Corsica is poorly unraveled. During the 1970s–80s, based on either lithostratigraphic or metamorphic field observations, various classifications of the belt have been proposed, but these classifications have been rarely matched together. Furthermore, through time, the internal complexity of large domains has been progressively left aside in the frame of large-scale geodynamic reconstructions. As a consequence, major open questions on the internal structure of the belt have remained unsolved. Apart from a few local studies, Alpine Corsica has not benefited of modern developments in petrology and basin research. This feature results in several uncertainties when combining lithostratigraphic and metamorphic patterns and, consequently, in the definition of an exhaustive architecture of the belt. In this paper we provide a review on the geology of Alpine Corsica, paying particular attention to the available lithostratigraphic and metamorphic classifications of the metamorphic terranes. These data are completed by a new and exhaustive metamorphic dataset obtained by means of thermometry based on Raman Spectroscopy of Carbonaceous Material (RSCM). This technique provides reliable insights on the peak temperature of the metamorphic history for CM-bearing metasediments. A detailed metamorphic characterization of metasediments, which have been previously largely ignored due to retrogression or to the lack of diagnostic mineralogy, is thus obtained and fruitfully coupled with the available lithostratigraphic data. Nine main tectono-metamorphic units are defined, from subgreenschist (ca. 280–300 °C) to the lawsonite-eclogite-facies (ca. 500–550 °C) condition. These units are homogeneous in metamorphism, laterally continuous and have characteristic lithostratigraphic features. This study also suggests a direct link between the pre-orogenic extensional setting and the present-day compressional structure of Alpine Corsica, indicating that large sections of subducted lithosphere were subducted and exhumed as coherent domains. These features provide important insight on the mechanism of stacking and exhumation of H*P* rocks, and make Alpine Corsica a unique reference for mountain-building processes in Tethyan-type orogens.

1. Introduction

Alpine Corsica offers a complete section through a Tethyan-type orogenic wedge, where almost all the tectonic units described in the Western Alps (*e.g.* Caron and Delcey, 1979, Durand-Delga, 1984, Lagabrielle and Lemoine, 1997, Schmid et al., 2004, Bousquet, 2008 and Beltrando et al., 2010a) are exposed over a 40 km section. The High-Pressure (H*P*) terranes of Alpine Corsica are the prevailing lithologies, and peak metamorphic mineral assemblages, especially lawsonite-bearing rocks, are exceptionally well preserved. Compared to the Western Alps, late deformation is much more localized, and inherited primary lithostratigraphic features are well preserved and have been commonly documented (*e.g.* Caron, 1977, Durand-Delga, 1978, Caron and Delcey, 1979, Caron et al., 1979, Caron and Bonin, 1980, Caron et al., 1981, Lahondère, 1983, Amaudric du Chaffaut et al., 1984, Durand-Delga, 1984, Amaudric du Chaffaut et al., 1985, Caron et al., 1990, Lahondère et al., 1992, Guieu et al., 1994, Rossi et al., 1994a, Rossi et al., 1994b, Vitale Brovarone, 2011, Vitale Brovarone et al., 2011a, Vitale Brovarone et al., 2011b and Meresse et al., 2012). Three major domains are classically recognized, the continental margin units, the Schistes Lustrés (SL) complex and the so-called Nappes Supérieures (*e.g.* Durand-Delga, 1978). Several lithostratigraphic studies are available for both the strongly metamorphosed SL complex and the lower grade terranes, *i.e.* the continental margin units and Nappes Supérieures (*e.g.* Caron, 1977, Nardi et al., 1978, Caron and Delcey, 1979, Caron and Bonin, 1980, Amaudric du Chaffaut, 1982, Durand-Delga, 1984, Lagabrielle and Lemoine, 1997 and Ferrandini et al., 2010). In the same way, different metamorphic zones have been defined based on field observation and local P–Temperature (*T*) estimates over the belt (*e.g.* Caron et al., 1981, Péquignot and Potdevin, 1984, Caron and Péquignot, 1986, Lahondère, 1988, Lahondère, 1996, Lahondère et al., 1999 and Oberhänsli et al., 2004). In general, most authors have given credence to either the lithostratigraphic or tectonometamorphic classifications, but their interdependencies, geographical boundaries and evolution are not well established throughout the belt. Successively, more interest has been paid to tectonics and geodynamics of Corsica in the frame of the surrounding Mediterranean system (*e.g.* Cohen et al., 1981, Faure and Malavieille, 1981, Malavieille, 1983, Péquignot and Potdevin, 1984, Harris, 1985, Gibbons et al., 1986, Jolivet et al., 1990, Fournier et al., 1991, Jolivet et al., 1991, Daniel et al., 1996, Lahondère, 1996, Jolivet et al., 1998, Molli and Tribuzio, 2004, Lacombe and Jolivet, 2005, Malasoma et al., 2006, Molli et al., 2006 and Molli and Malavieille, 2010). The progressive shift from a lithostratigraphic to a tectonometamorphic/geodynamic approach resulted in a necessary simplification of the structure of the belt, and only the three major domains of the belt (SL, continental margin units and Nappes Supérieures) are commonly highlighted. This aspect, however, has resulted in several progressive assumptions regarding the structure of the SL complex, its origin and its geometrical and chronological relationships with the surrounding domains. Furthermore, the lack of lithostratigraphic and metamorphic studies in the SL during almost thirty years (a part from a few cases which are reviewed in the following), left several open problematic issues unsolved, and kept the Schistes Lustrés aside from fundamental improvements in basin research and quantitative petrology.

In the last years, authors have reconsidered some of the debated aspects of the Schistes Lustrés and other domains of the belt in the light of modern information about passive margins in Alpine Corsica and in the Western Alps (Rossi et al., 2002 ; Beltrando et al., 2010, 2012; Vitale Brovarone et al., 2011a and Meresse et al., 2012). Moreover, recent development in the petrological study of metasediments, and, in particular, the thermometric estimates based on Raman spectroscopy of Carbonaceous Material (RSCM) has allowed a more systematic and detailed study of metamorphic terranes independently from the extent of retrogression and from the occurrence of diagnostic mineralogy (e.g. Beyssac et al., 2002a). This technique thus allows a deep coupling between petrology of metasediments and lithostratigraphy, which is fundamental in the metasediment-rich terranes of Alpine Corsica as already demonstrated successfully in similar geological units of the Western Alps (*e.g.* Gabalda et al., 2009 and Plunder et al., 2012).

The purpose of this study is to discuss the internal structure of Alpine Corsica by coupling the available lithostratigraphic, structural and metamorphic data and an exhaustive dataset of RSCM thermometry. Our dataset permits to define a high-resolution distribution of large tectonometamorphic units and their relationships with the main lithostratigraphic features described in the belt. As a result, a strong link between the paleogeography of the units and their Alpine tectonometamorphic evolution is established. We also conclude that Alpine Corsica represents a nice example of orogenic belt where large segments of subducted lithosphere are coherently exhumed back from various *P*–*T* conditions, from very low-grade metamorphism up to the lawsonite-eclogite facies conditions. As metamorphic conditions of the H*P* units of Alpine Corsica are comparable with many other H*P* belts (*e.g.* the Western Alps), exhumation mechanism observed in this belt (*i.e.* large coherent segments of subducted lithosphere) may serve as a reference for other Tethyan-type belts affected by stronger late deformation.

2. Geological setting

The island of Corsica occupies a central position in the Western Mediterranean sea (Fig. 1). It consists of two main geological domains (Fig. 2 a): the mostly granitic Hercynian Corsica, to the west and south, which largely escaped Alpine orogenesis (*e.g.* Durand-Delga, 1984), and Alpine Corsica, to the north-east which consists of a complex stack of variably metamorphosed units derived from oceanic and minor continental basement rocks of the Tethyan realm. Several hypotheses have been proposed for the Alpine subduction beneath Corsica, involving either east-dipping or west-dipping slabs (*e.g.* Nardi, 1968, Boccaletti et al., 1971, Mattauer et al., 1981, Durand-Delga, 1984, Principi and Treves, 1984, Harris, 1985, Warburton, 1986, Dallan and Puccinelli, 1995, Lahondère, 1996, Jolivet et al., 1998, Lahondère et al., 1999, Faccenna et al., 2001, Rossetti et al., 2002 and Faccenna et al., 2004), or the result of a tectonic inversion from one to the other (Elter and Pertusati, 1973, Doglioni et al., 1998, Molli and Tribuzio, 2004, Molli, 2008, Argnani, 2009 and Molli and Malavieille, 2010). At a large scale, Alpine Corsica is classically subdivided into three major domains (*e.g.* Durand-Delga, 1984, Jolivet et al., 1990, Malavieille et al., 1998 and Molli, 2008) (Fig. 2 a): 1) the continent-derived units, 2) the SL complex, and 3) the *Nappes Supérieures* (uppermost thrust sheets). These three ensembles overthrust to the east the Hercynian autochthonous basement and its Permian to Eocene sedimentary cover.

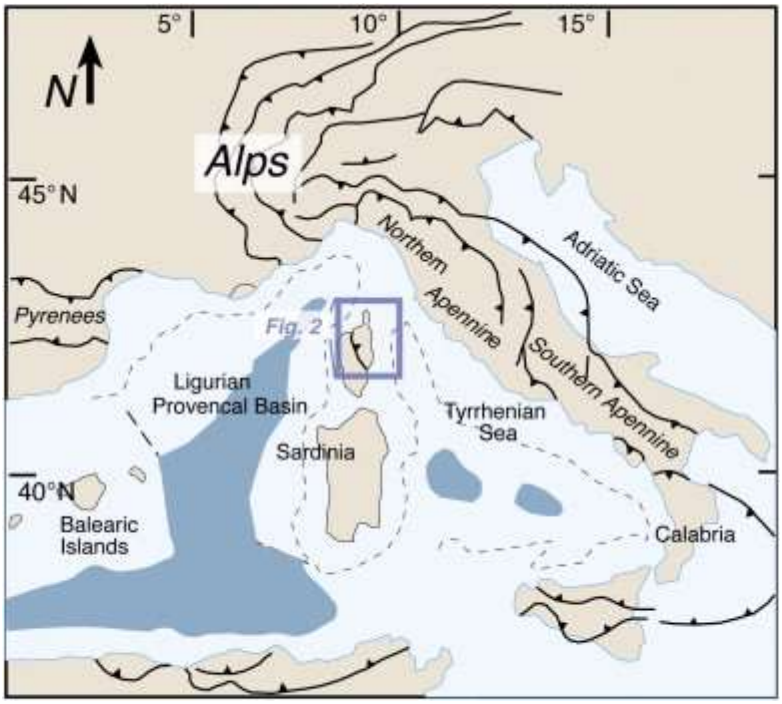


Fig. 1.

Simplified regional setting of Alpine Corsica in the western Mediterranean area. Modified from Molli and Malavieille (2010)

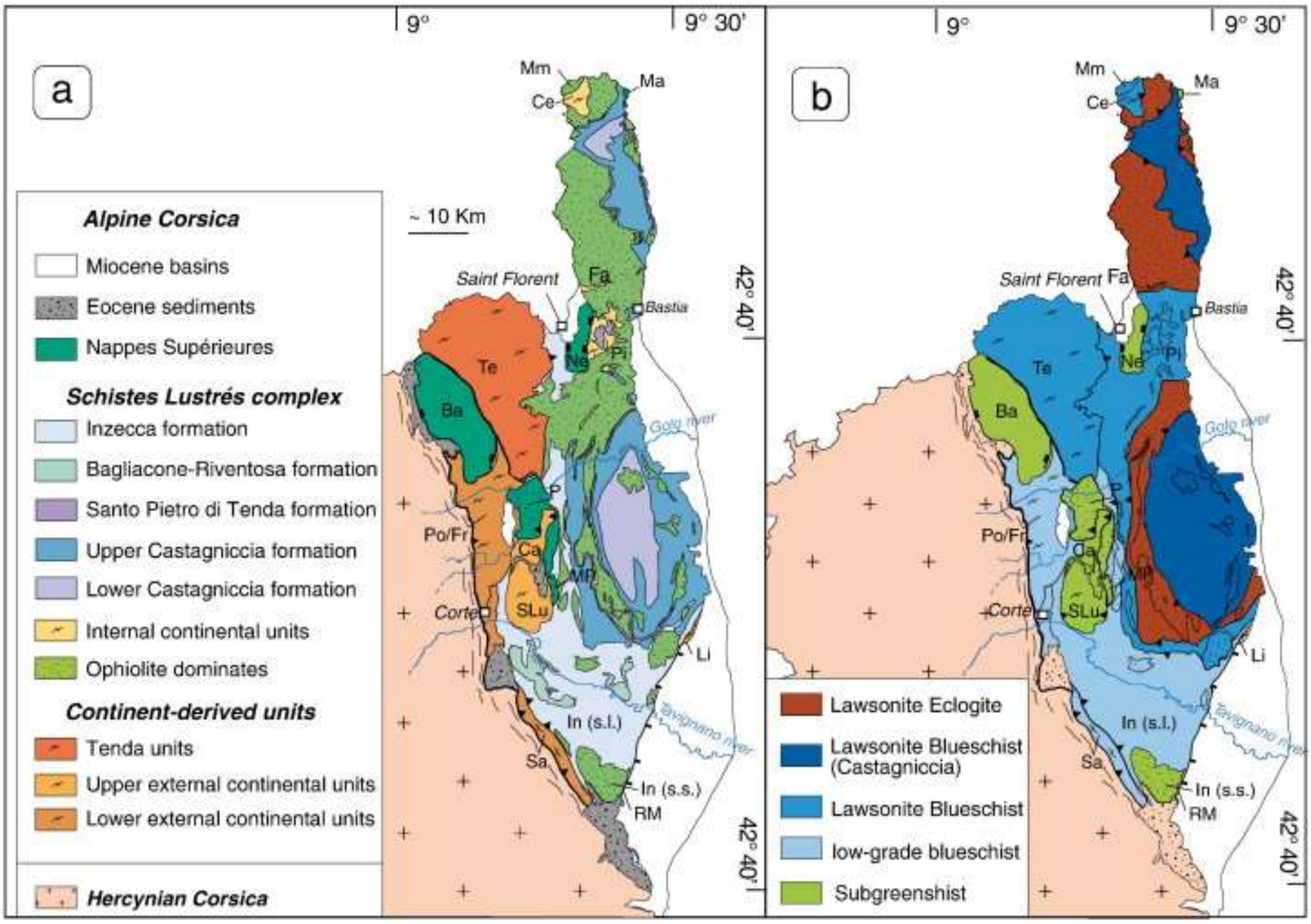


Fig. 2.

a: Geological map of Alpine Corsica. The Schistes Lustrés complex has been subdivided on the basis of the available lithostratigraphic classification (cf. text for references). b: Metamorphic chart of Alpine Corsica, compiled after Lahondère (1996) , Jolivet et al. (1998) , Molli et al. (2006) , Molli (2008) , Vitale Brovarone et al., 2011a and Vitale Brovarone et al., 2011b, Jackson and Ohnenstetter (1981) , Levi et al. (2007) , Caron et al. (1981) , Oberhänsli et al. (2004) . Mm: Monte Maggiore peridotite unit; Ce: Centuri continental slice; Ma: Macinaggio flysch; Fa: Farinole continental slice; Ne: Nebbio unit; Pi: Serra di Pigno continental slice; Tenda unit; Ba: Balagne unit; Po: Popolasca unit; Fr: Francardo unit; Ca: Caporalino unit; SLu: Santa Lucia; P: Pineto ophiolitic unit; MP: Monte Piano Maggiore ophiolitic unit; Sa: Sampolo; In: Inzecca; RM: Rio Magno. Note that the boundaries separating the different units/formations in the two figures match only in part.

2.1. The continent-derived units

Continental basement slivers are abundant in Alpine Corsica and are mostly localized in the western part of the belt (Fig. 1 a). They can be subdivided in two main groups, the Tenda unit and the External Continental units, also known as "parautochthonous" units. (*e.g.* Marroni and Pandolfi, 2003, Molli et al., 2006, Malasoma and Marroni, 2007 and Molli, 2008 and refs therein).

2.1.1. The Tenda unit

This unit is located in the westernmost part of Alpine Corsica, to the west of Saint Florent (Fig. 2). To the west, it is separated from the Balagne Nappe (Nappes Supérieures, see below) by a sinistral strike-slip-normal fault also known as Ostriconi Fault (Maluski et al., 1973, Jourdan, 1988, Lacombe and Jolivet, 2005 and Molli, 2008). To the east, it is separated from the SL complex by a thick polyphase shear zone, known as the East Tenda Shear Zone (ETSZ) that is interpreted as a H*P* shear zone reactivated during extension at lower grade/post orogenic conditions (*e.g.* Jolivet et al., 1990, Jolivet et al., 1991, Daniel et al., 1996, Gueydan et al., 2003, Molli et al., 2006 and Maggi et al., 2012). The Tenda massif is mainly composed by amphibole-biotite granodiorites (303 Ma) associated to cogenetic dacitic volcano-sedimentary formations (Lahondère et al., 1999). Both rock-types are intruded by Early Permian leucomonzogranites (280 to 286 ± 3.9 Ma. Rossi et al., 2002), or by a stratified gabbroic complex dated at 289.6 ± 2.5 to 274 ± 4 Ma cross cut by basaltic and rhyolitic dikes (U–Pb zircon, Ohnenstetter and Rossi, 1985, Cocherie et al., 2005 and Tribuzio et al., 2009). Scattered outcrops of Mesozoic to Eocene (?) sedimentary cover are also observed (Durand-Delga, 1984). This continent-derived sliver underwent Alpine H*P* metamorphism in the blueschist-facies condition (Stam, 1952, Delcey and Meunier, 1966, Gibbons and Horak, 1984, Tribuzio and Giacomini, 2002, Molli and Tribuzio, 2004, Molli et al., 2006 and Maggi et al., 2012) associated with a top-to-the-west kinematics (*e.g.* Mattauer et al., 1981, Jolivet et al., 1990, Gueydan et al., 2003, Molli et al., 2006 and Maggi et al., 2012). Published *P–T* estimates vary from 0.8 to 1.4 GPa, 350–450 °C (Egger and Pinaud, 1998), to 0.8 GPa/300 °C and 1.1 GPa/500 °C on metarhyolite (Tribuzio and Giacomini, 2002, Molli and Tribuzio, 2004 and Molli et al., 2006). Ar–Ar geochronology on H*P* phengite provided dates between > 45 Ma and 32 Ma (Brunet et al., 2000). Recently, ages of 54 ± 8 Ma and 48 ± 18 Ma are proposed for the H*P* metamorphism along the ETSZ (U–Pb acmite-phengite and ox/sulph coating and rutile, respectively; Maggi et al., 2012). A late greenschist-facies metamorphic event associated with a top-to-the-east sense of shear was also documented (Mattauer et al., 1981, Warburton, 1986, Waters, 1990, Jolivet et al., 1990 and Daniel et al., 1996). This extensional phase was dated between 32 and 25 Ma (Brunet et al., 2000). Importantly, this unit and the westernmost part of the SL complex were already associated at peak metamorphism under blueschist facies conditions (Molli et al., 2006 ; also confirmed by our dataset, cf. 5 and 6), indicating their early association/juxtaposition prior to the late top-to-the-east extensional tectonics (*e.g.* Jolivet et al., 1990, Jolivet et al., 1991 and Fournier et al., 1991).

2.1.2. The External Continental units

These units (Annunciata-Volparone/Popolasca/Corte/Razzo Bianco/Santa Lucia/Caporalino slices) represent portions of a distal continental margin with associated Permian to Eocene sedimentary cover (*e.g.* Lahondère, 1996). On the basis of their structural position with respect to the SL complex, these units can be subdivided in two groups.

- The Lower External Continental units (Annunciata-Volparone/Popolasca/Corte/Razzo Bianco units), which are located all along the boundary between Hercynian and Alpine Corsica (Fig. 2 a). These units lie structurally below the SL complex and, locally, below the Nappes Supérieures (*i.e.* Balagne unit). They are locally characterized by low-grade blueschist metamorphic conditions documented in the Volparone area (0.6 ± 0.15 GPa; 325 ± 20 °C, Malasoma and Marroni, 2007), in the Popolasca unit (300–370 °C; 0.50–0.80 GPa, Malasoma et al., 2006) and, to the south, in the Sampolo area (Netelbeek, 1951 and Garfagnoli et al., 2009) (Fig. 2 b). Importantly, evidence of blueschist metamorphism is found in Eocene *nummulite*-bearing rocks in the Corte-Popolasca area (Egal and Caron, 1988 and Bezert and Caby, 1989). The upper biostratigraphic limit of this unit was recently updated to a Priabonian age in the Corte area (Ferrandini et al., 2010).

- The Upper External Continental units (Santa Lucia-Falconaia/Caporalino/Linguizeta units), which structurally overlay the SL complex and the Tenda unit and show slightly lower metamorphic conditions (no stable Na-amphibole or lawsonite) compared to the Lower External Continental units, possibly subgreenschist facies of about 300-350 °C (Zibra, 2006). The Santa Lucia Unit consists of a crystalline basement and an Upper Cretaceous sedimentary cover (Libourel, 1988 ; Libourel in Rossi et al., 1994a, Zibra, 2006 and Zibra et al., 2010). The Santa Lucia Unit includes serpentinite and a stratified mafic complex with intercalations of the hosting granulitic paragneiss. This basement shows a polyphase pre-Alpine evolution characterized by a Permian-to-Jurassic H*T* metamorphism, possibly resulting from the first stages of lithospheric thinning of the Tethys margin (Rossi et al., 2006 and Zibra, 2006). The metasedimentary cover consists of a meta-conglomerate known as the “Tomboni conglomerate”, containing clasts of granite, rhyolite, mafic rocks, metamorphic rocks and carbonate, and an Upper Cretaceous flysch of silicoclastic or carbonatic composition also known as the “Tralonca flysch”. The Santa Lucia Unit tectonically overlies the Caporalino-Pedani Unit and its Eocene cover (see below). A small slice of poorly metamorphosed continent-derived rocks, also known as Falconaia slice, overlies the Tenda massif, and is correlated with the Santa Lucia Unit (Rossi et al., 2001). The Caporalino-Pedani Unit is characterized by very low-grade Alpine metamorphism (Rieuf, 1980, Rodriguez, 1981, Rossi et al., 1994a and Rossi et al., 1994b). It consists of a Paleozoic crystalline basement, and its Permian to Eocene sedimentary cover, which includes Permian volcanic deposits, Triassic to Lower Jurassic carbonates, Middle Jurassic limestones with conglomeratic lenses resting unconformably onto the Lower Jurassic terms, conglomerates and breccias with crystalline and carbonate clasts, arkoses, limestones with lenses of cherts. A recent work considers the Caporalino Unit as an Eocene “clastic wedge” accumulated in a basin located between the European foreland and the deforming accretionary wedge (Cascella et al., 2011). On a structural point of view, this unit may be considered as a tectonic window beneath the Schistes Lustrés complex and the Pineto massif (Nappes Supéreures) (Rossi et al., 1994a). In the southern part it is located below the continent-derived Santa Lucia unit; otherwise, its southwestern part is juxtaposed onto the continental margin units of the Corte are. For these reasons, especially the relationships with the Schistes Lustrés complex, the Caporalino Unit has been classically considered as part of the European margin (Peybernès et al., 2001 and reference therein). However, based on the results of this study, a different structural position will be proposed.

2.2. The Schistes Lustrés (SL) complex

This group of units occupies the eastern flank of the Corsica belt (Fig. 2), and consists in a complex stack of metamorphic units folded together within a N–S antiform (*e.g.* Caron, 1977, Jolivet et al., 1990 and Molli and Malavieille, 2010). Two axial culminations of this antiformal structure (Fig. 2 and Fig. 4) are responsible for two metasediment-rich domains, cropping out in the Southern Alpine Corsica (SAC), *i.e.* the so-called Castagniccia region, and in the Northern Alpine Corsica (NAC), *i.e.* in the Cap Corse region, respectively. The periclinal terminations of these antiforms define a Central Axial Depression (CAD), which separates these structures in the area comprised between Bastia and Saint Florent (Fig. 2). From a lithological point of view, the SL complex consists of Ligurian Tethys metaophiolites and metasedimentary cover rocks (e.g.

Lagabrielle and Lemoine, 1997). Thin slices of continental basement rocks, the 'Internal Continental Units' (Centuri/Serra di Pigno/Farinole/Morteda/San Petrone/Golo/Sant'Andrea di Cotone units), are interlayered within the SL complex. Their association with ophiolites is interpreted either as related to the Alpine orogeny (*e.g.* Caron and Delcey, 1979, Mattauer et al., 1981, Péquignot and Potdevin, 1984, Jolivet et al., 1990, Fournier et al., 1991 and Lahondère et al., 1999) or as pre-Alpine, Tethyan rift-related continental extensional allochthons at ocean-continent transition zones (*e.g.* Lahondère, 1996, Rossi et al., 2002, Vitale Brovarone, 2011, Vitale Brovarone et al., 2011a, Vitale Brovarone et al., 2011c and Meresse et al., 2012). In this latter case, the Permian H*T* metamorphism found in these slices is interpreted as resulting from the first stages of lithospheric thinning during rifting (*e.g.* Rossi et al., 2002, Rossi et al., 2006 and Martin et al., 2011).

In the literature, the SL complex has been alternatively considered as either a large and unique body, or as a more complex stack of units differing in their nature and metamorphic evolution. Although the former assumption was justified for regional interpretation, it has sometimes resulted in arguable interpretations (cf Section 6.3). In the latter case, several different and locally incompatible classifications do exist in the literature. Some authors subdivided the SL complex into two subgroups, the Upper SL and the Lower SL, based on (i) their relative structural position and metamorphism (*e.g.* Durand-Delga, 1978 and Durand-Delga, 1984), or (ii) their reciprocal relationships with the 'Internal Continental Units' (Dallan and Puccinelli, 1995). This latter structural classification, which implies a tectonic distinction among the three different domains (*i.e.* Upper SL, Lower SL and Internal Continental Units), is incompatible with the interpretation of these slices of continental basement as primarily associated to ophiolites prior to subduction (*e.g.* Vitale Brovarone et al., 2011a, Vitale Brovarone et al., 2011c and Meresse et al., 2012 and references therein). Other authors subdivided the SL complex into three groups based on their lithological features and structural position, namely continental, transitional and oceanic units (Lahondère and Lahondère, 1988, Lahondère and Caby, 1989, Lahondère et al., 1992 and Lahondère, 1996: Lahondère et al., 1999 and Rossi et al., 2001). Alternatively, most available geological maps and tectonic schemes (*e.g.* 1:50,000, BRGM, France) are built in a lithostratigraphic (Fig. 2 a) or tectono-metamorphic (Fig. 2 b) perspective. These two latter classifications will be used in the following, but, as they do not match uniformly throughout the belt, they are presented separately.

2.2.1. Lithostratigraphy of the Schistes Lustrés complex

The SL complex consists of meta-ophiolites and associated metasedimentary cover rocks. Meta-ophiolites include serpentinites, metagabbros and metabasalts interpreted to reflect a Tethyan-type, magma-poor Jurassic basin (Ohnenstetter et al., 1975, Ohnenstetter and Ohnenstetter, 1980, Ohnenstetter et al., 1981 and Vitale Brovarone et al., 2011a). The magmatic age of these rocks is constrained at 161 ± 1 Ma (U–Pb zircon, Ohnenstetter et al., 1981), 181.4 ± 6 (k-Ar amphibole, Beccaluva et al., 1981) or in the range comprised between 162 and 155 Ma (Sm–Nd plag–whole rock–cpx, Rampone et al., 2009). Geochemical data of metaophiolites mostly indicate a N-MORB affinity (Saccani et al., 2008). To the north, a sliver of well-preserved peridotite, also known as the 'Monte Maggiore peridotite', outcrops over a large area (*e.g.* Jackson and Ohnenstetter, 1981, Romairone, 1996, Rampone et al., 2008, Rampone et al., 2009 and Piccardo and Guarnieri, 2010).

Metasediments are the most abundant rock type, and four main metasedimentary formations have been distinguished on the basis of their stratigraphic features (such as the occurrence of carbonate-rich layers or continent-derived debris). Each of these sequences is referred to a specific paleogeographic domain (*e.g.* Delcey, 1974, Caron and Delcey, 1979, Caron and Bonin, 1980, Lahondère et al., 1992, Lahondère et al., 1994 and Guieu et al., 1994) (Fig. 2 a). A detailed description of these lithostratigraphies, which also include different types of ophiolitic basement, is beyond the aim of this paper, and only the most remarkable features are reviewed here.

1. The *Castagniccia formation* (Delcey, 1974, Caron and Delcey, 1979 and Caron et al., 1979). Its name derives from the Castagniccia region (SAC), where this sequence was defined. It crops out in both the SAC and the NAC, forming large metasediment-rich domains that are internally subdivided into two different sequences that have been variably labeled throughout the belt: a lower carbonate-rich sequence, hereafter labeled as *Lower Castagniccia* sequence [*e.g.* Brando unit *s.s.* (Lahondère et al., 1992), Olmo unit (Lahondère et al., 1994); Porri-Ortale unit (Guieu et al., 1994)], and an upper carbonate-poor sequence, hereafter named *Upper Castagniccia* sequence [Vescovato sequence (Lahondère et al., 1992 and Lahondère et al., 1994)]. In the SAC, *Upper Castagniccia* rocks are also observed to the west associated with *Santo Pietro di Tenda* sediments (see below) (Rossi et al., 1994a and Rossi et al., 1994b).

2. The *Santo Pietro di Tenda formation* (Caron and Delcey, 1979). This formation, which was also labeled as “Sisco unit” in the NAC (Lahondère, 1983, Lahondère et al., 1992 and Lahondère et al., 1994), forms a relatively thin and continuous rim bordering meta-ophiolites and slices of continental basement rocks. Continent-derived debris are characteristic of this formation, which is thus referred to an Ocean-Continent Transition (OCT) paleogeographic domain (*e.g.* Caron and Delcey, 1979, Vitale Brovarone et al., 2011a and Vitale Brovarone et al., 2011c). In the SAC, this formation is interlayered within *Castagniccia* metasediments (Fig. 2 a), and a clear boundary between these two formations is not well established. For this reason, some authors proposed that the *Santo Pietro di Tenda formation* was stratigraphically covered by the *Castagniccia formation* (Caron and Delcey, 1979).

3. The poorly documented *Bagliacone-Riventosa formation*, which crops out in a restricted area along the Tavignano valley (Caron, 1977 and Amaudric du Chaffaut et al., 1985) (Fig. 2 a) and, further south, in the Prunelli area, where its emplacement predates the deposition of unmetamorphosed Eocene sediments (Egal, 1992).

4. The *Inzecca* (*s.l.*) *formation*, which is representative of a typical Tethyan supra-ophiolitic sedimentary sequence now consisting of, from the lower to the upper term, meta-radiolarite, marbles, impure marbles, calcschists and metapelites (*i.e.* “Erbajolo formation”) (e.g. Amaudric Du Chaffaut et al., 1972 and Lagabrielle and Lemoine, 1997). This formation represents the only portion of the SL complex whose contacts with other units of the belt are well exposed: to the west, these metasediments are structurally ontop of the Tenda unit and part of the External Continental units (see below), while in other places it lies below the continent-derived Santa Lucia and Caporalino Units and the Nappes Supérieures (see below).

2.2.2. Metamorphism in the SL complex

Several works have divided the SL complex of Alpine Corsica in a number of small slices of various nature (metaophiolithes, continental basement slivers or metasediments) and separated by Alpine tectonic contacts (*e.g.* Péquignot and Potdevin, 1984, Fournier et al., 1991, Rossi et al., 1994a, Rossi et al., 1994b, Lahondère, 1996, Lahondère et al., 1999 and Rossi et al., 2001). This approach is particularly evident in the official geological maps (1:50,000, BRGM), where tectonic schemes report several small tectonometamorphic units (*e.g.* Rossi et al., 1994a, Rossi et al., 1994b and Rossi et al., 2001). The main limit to this approach is the lateral incompatibility among neighboring sheets, which results in the difficulty of grouping units with similar tectonometamorphic evolutions. The definition of metamorphic domains has been several times limited to diagnostic lithologies, *i.e.* metamafics. A detailed metamorphic zonation is available only locally [*e.g.* the Golo valley (Lahondère, 1996)] based on diagnostic lithologies, such as metamafics. There, four tectono-metamorphic domains are distinguished. These domains are, from the bottom to the top (Fig. 2 b):

1. A lawsonite-blueschist facies, metasediments-rich zone, coinciding with the *Castagniccia* metasediments (Lawsonite-Blueschist Castagniccia in Fig. 2 b). The petrological dataset from this region is limited, and peak *P*–*T* conditions from the SAC region were estimated at about 1.4–1.7 GPa and 300–380 °C by means of qualitative traditional petrology (Jolivet et al., 1998).

2. A lawsonite-eclogite facies, meta-ophiolite-rich zone (Law-Ecl in Fig. 2 b), also including slivers of continental basement rocks (*i.e.* 'Internal Continental Units'). This unit is also known as Morteda-Farinole-Volpajola unit (Lahondère, 1988, Lahondère and Lahondère, 1988, Lahondère and Caby, 1989 and Paperini, 2004). Eclogite assemblages are reported in several localities, from the south, to the north (Dal Piaz and Zirpoli, 1979, Caron et al., 1981, Péquignot and Potdevin, 1984, Lahondère, 1996, Miller et al., 2000, Ravna et al., 2010 and Vitale Brovarone et al., 2011b). Ophiolitic and continental metamafics are characterized by variably preserved omphacite + Na-amphibole + Ca-amphibole + lawsonite + garnet + phengite mineral assemblages (*e.g.* Lahondère, 1996, Ravna et al., 2010 and Vitale Brovarone et al., 2011b). Available peak *P*–*T* estimates for this unit are somewhat heterogeneous, and have shifted toward higher conditions mainly due to the progress of quantitative petrology methods: 0.8 GPa and 300 °C from the Sant'Andrea di Cotone area (Caron et al., 1981), 1.5 GPa and 500 ± 50 °C from the Farinole area (Lahondère, 1996), 1.3 GPa and 455 ± 35 °C from the Golo valley (Lahondère, 1996), 1.9–2.6 GPa, 335–420 °C from the Lancône valley (Ravna et al., 2010) and 2.2–2.6 GPa and 520 ± 20 °C from the Monte San Petrone area (Vitale Brovarone et al., 2011b).

3. A lawsonite blueschist-facies zone (Law-Bs in Fig. 2 b) characterized, similarly to the previous domain, by meta-ophiolites, continental slivers and associated metasediments (*e.g.* Faure and Malavieille, 1981, Lahondère, 1996 and Vitale Brovarone et al., 2011a). In the SAC, this unit is also known as Campitello unit (Lahondère and Caby, 1989, Lahondère, 1996 and Paperini, 2004), or as Morosaglia unit (Sedan, 1983 and Rossi et al., 1994a). This unit characterizes most of the CAD, especially the Serra di Pigno area. Garnet is rare and only locally occurs in Mn-rich rocks in the Serra di Pigno (Lahondère, 1996) and Zuccarello (Vitale Brovarone et al., 2011a) areas. The most characteristic minerals are jadeite + Na-amphibole + lawsonite + phengite mineral assemblages (Lahondère, 1996). *P*–*T* estimates from this domain are 0.6–0.8 GPa and 300 ± 50 °C obtained from the Serra di Pigno area and 1.0 GPa and 350 °C from the Campitello area (Lahondère, 1996). In this unit, spectacular structures and mineralogies are locally observed. To the east of Saint Florent (Cima di Gratera area) pseudotachylytes formed under H*P* conditions are observed (Austrheim and Andersen, 2004 and Andersen and Austrheim, 2006). Slightly to the south, in the Cima di Malaspina area, fresh aragonite, grossular garnet and wollastonite are documented associated with intense H*P* metasomatism (Chopin et al., 2008, Malvoisin et al., 2011 and Galvez et al., submitted for publication).

4. A low-grade blueschist meta-ophiolite-rich domain (low-grade Bs in Fig. 2 b). This unit is also known as Lento unit (*e.g.* Lahondère et al., 1999, Paperini, 2004 and Levi et al., 2007). Previous petrological investigations yielded $P = 0.8 \pm 0.2$ GPa and $T < 450$ °C from the Lento area (Golo valley, Levi et al., 2007).

Otherwise, in the NAC few detailed tectono-metamorphic observations are available, and are mostly restricted to the northernmost region (*e.g.* Malavieille, 1983, Lahondère, 1983, Harris, 1985 and Lahondère and Lahondère, 1988: Jolivet et al., 1991, Lahondère et al., 1992 and Rossi et al., 1994b). This is mainly due to the abundance of strongly retrogressed ophiolite-type lithologies and to the extent of the vegetation cover/weathering. Despite these limitations, the same large-scale structure as presented in the SAC can be observed: i) a lower metasedimentary-rich domain, ii) an eclogitic ophiolite-rich domain (*e.g.* Dal Piaz and Zirpoli, 1979), and iii) a blueschist domain, consisting of the Centuri continental-basement sliver and Monte Maggiore peridotites, where jadeite was reported (Jackson and Ohnenstetter, 1981), which possibly includes part of the ophiolitic rocks cropping out along the western border of the NAC (cf. Harris, 1985). No clear equivalent of low-grade blueschist terranes are documented in the NAC. A global metamorphic cartography that takes into account the above local observation is provided in Oberhänsli et al. (2004) .

2.3. The “Nappes Supérieures”

The Balagne, Nebbio, Rio Magno, Pineto and Macinaggio units, which make up the uppermost structural ensemble of the present-day nappe pile, consist in a complexly deformed association of ophiolitic and continent-derived rocks (Fig. 2 a). These nappes are characterized by subgreenschist mineral assemblages in mafic rocks (Dal Piaz and Zirpoli, 1979, Péquignot and Potdevin, 1984, Bezert and Caby, 1988, Fournier et al., 1991 and Caron, 1994). *P*–*T* metamorphic conditions are estimated either at P < 0.5 GPa, T < 350 °C (Nardi et al., 1978, Amaudric du Chaffaut and Saliot, 1979, Durand-Delga, 1984, Dallan and Puccinelli, 1995, Saccani et al., 2000 and Padoa and Durand-Delga, 2002) or at P = 0.3–0.4 GPa, *T* = 150–200 °C (Marroni and Pandolfi, 2003) (Fig. 2 b). The Balagne unit is the westernmost unit of this group. It is located west of the Tenda massif, from which it is separated by a high-angle normal fault (cf. Section 2.1.1). It is formed by a pile of tectonic units superposed on the Hercynian crystalline basement and its Middle Eocene sedimentary cover. Both the tectonic pile and the base-thrust separating it from the basement are deformed in a regional N–S trending synformal fold. To the west, the Balagne unit is limited at the base by a group of thrust sheets, part of the Lower External Continental units, whose sedimentary cover reach Eocene age (Durand-Delga, 1984 and Marroni et al., 2001). From a lithological point of view, the Balagne unit consists of poorly metamorphosed Jurassic ophiolites sequences of Ligurian affinity and associated Jurassic–Cretaceous olistostromic sequences. It overthrusts the Hercynian Corsica and its Eocene sedimentary cover (Annunciata formation) (*e.g.* Durand-Delga, 1984 and Marroni and Pandolfi, 2003). Continent-derived deposits intercalated at different levels in the sequence, from the Jurassic (arkosic layers within basaltic effusions; Durand-Delga et al., 1997) to the Cretaceous turbiditic sequence known as Alturaja formation (Sagri et al., 1982 and Marroni et al., 2004). The source area of these sediments is interpreted by some authors to derive from the Corsica continental paleomargin (Durand-Delga et al., 1997 and Marroni and Pandolfi, 2003), while other authors favor a position close to a continental microblock (cf. Section 3 ; Molli, 2008 and Molli and Malavieille, 2010). All the above features, together with geochemical affinities (Saccani et al., 2008), indicates that the Balagne unit was located in an OCT zone. The Balagne nappe also comprises a Upper Cretaceous carbonatic flysch, also known as Narbinco unit, which is correlated with the Macinaggio flysch, cropping out along the eastern coast of Cap Corse (Nardi et al., 1978 and Dallan and Nardi, 1984). Some authors (Dallan and Nardi, 1984, Durand-Delga, 1984, Caron et al., 1990 and Rossi et al., 2001) envisaged a similarity between these Upper Cretaceous deposits and those observable in the Santa Lucia Nappe west of Corte *i.e.* the Tralonca Flysch. Futhermore, some authors have suggested analogies between the Narbinco flysch and the Helminthoid Flysch of the Ligurian Alps and Northern Apennines (Durand-Delga, 1978 and Durand-Delga, 1984).

The Nebbio unit is a little non-metamorphic thrust sheet, which lies over the metamorphic terranes of the SL complex (Rossi et al., 2001 and references therein). The structure of this unit is similar to the Balagne unit, with a pile of thrust sheets deformed within a regional open N–S synformal fold. On the basis of the lithological features, two thrust sheets can be distinguished. The lower one (Croix di Menta units) is formed by continental basement rocks (pre-Hercynian metamorphic rocks) and its sedimentary cover, made of a succession similar to that of the Corte or Caporalino-Pedani Units (Permian-Upper Eocene) (Rossi et al., 2001). The upper group (Mortala-Tramonti Units) is characterized by an ophiolitic basement and its associated sedimentary cover. The ophiolites are represented by T-MORB pillow basalts, like those of the Balagne unit (Saccani et al., 2000 and Saccani et al., 2008).

The Rio Magno unit crops out discontinuously at the south-eastern border of Alpine Corsica, along the Neogene normal fault that separates the Alpine units from the Miocene sedimentary succession of the Aleria plain (Fig. 2, Fig. 3 and Fig. 4j). This unit has a structural position ontop of the Schistes Lustrés complex (Inzecca Unit s.l.), and it is formed by an ophiolitic basement and a sedimentary cover, both non metamorphic (Padoa et al., 2001). The ophiolites consist of pillows and massive basalts, with a N-MORB affinity (Padoa et al., 2001), unlike those of the Balagne and Nebbio units. The sedimentary cover starts with an irregular alternance of shales and micritic limestones of Middle Berriasian-Valanginian age, which correlate with the Palombini Shales of Northern Apennines (Padoa and Durand-Delga, 2002). The terranes of the Rio Magno unit are mainly deformed by asymmetric SE-vergent folds.

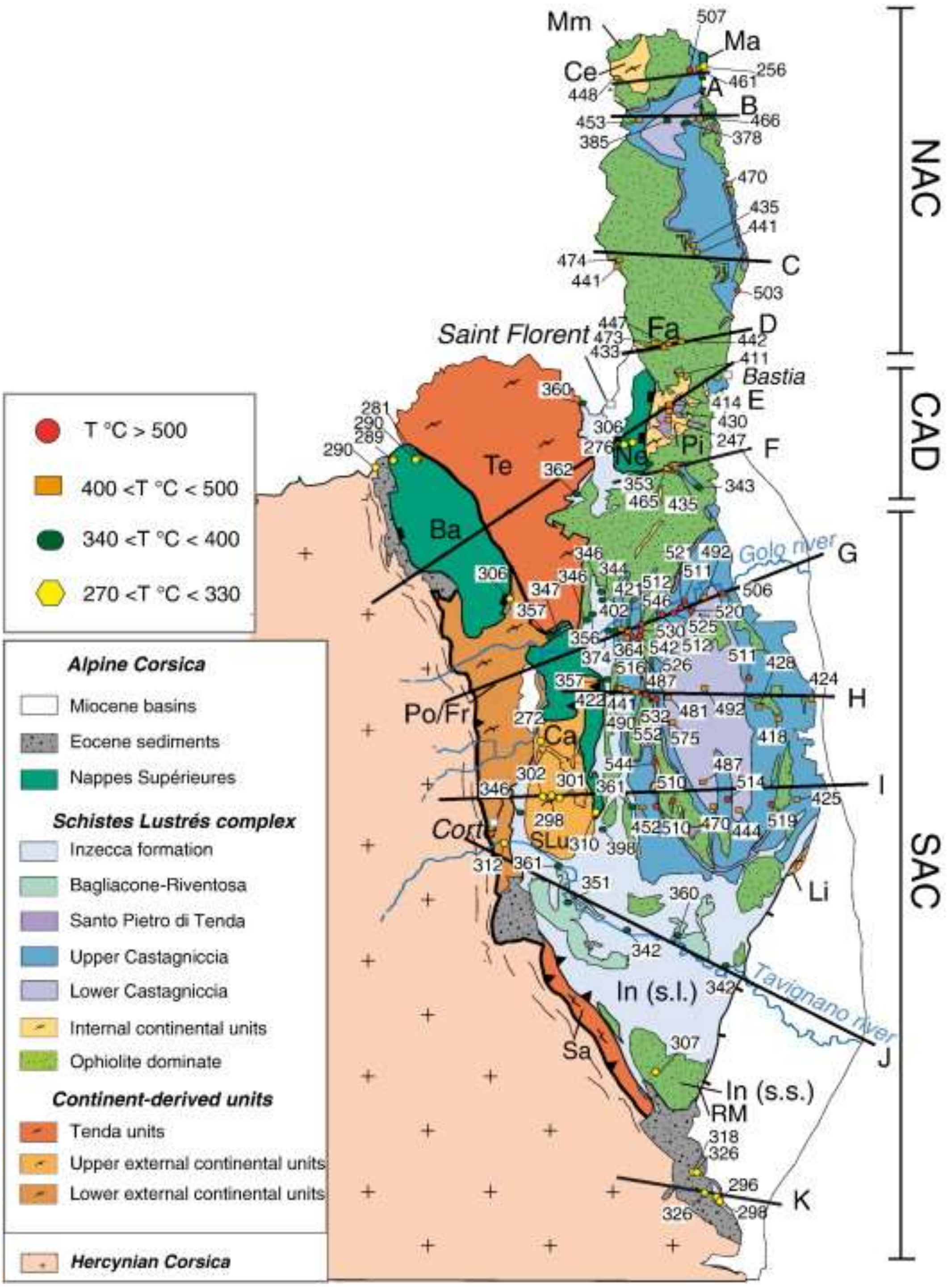


Fig. 3.

Geological map of Alpine Corsica showing peak metamorphic temperatures estimated by means of RSCM thermometry and position of interpretative cross sections presented in Fig. 4 . cf. Fig. 2 a for legend.

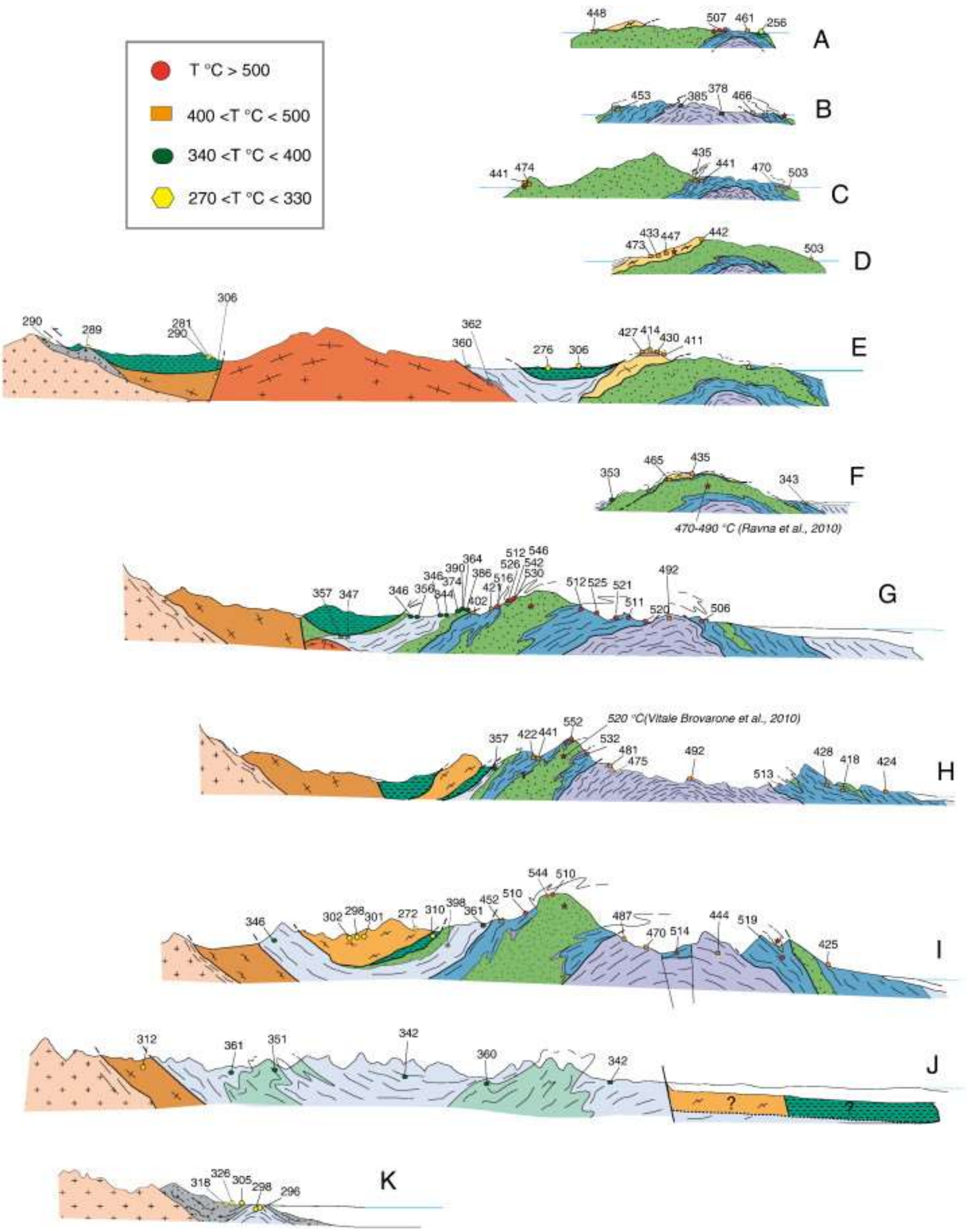


Fig. 4.

Geological cross sections compiled after the 1:50,000 geological maps (BRGM) and original data from this study. Stars indicate the location of eclogitic assemblages (cf. Section 2 for references). In all cross sections, vertical distances are exaggerated with Height = 2Length. Shaded symbols for RSCM-*T* refer to samples projected on the cross-section topography (cf. Fig. 3 for color codes).

The Macinaggio unit, which crops out along the eastern coast of the Cap Corse, is a little thrust sheet lying on the Schistres Lustrés complex by means of a late extensional tectonic contact (Durand-Delga, 1984 and Jolivet et al., 1991). It is mainly formed by a carbonatic Upper Cretaceous flysch (Nardi et al., 1978, Dallan and Nardi, 1984 and Durand-Delga, 1984), which is tectonically superposed on a tectonized succession similar to the basal part of the Caporalino-Pedani unit (Permian–Lower Jurassic, Durand-Delga, 1984).

3. Origin, geochronology and available models for the evolution of Alpine Corsica

Although many contacts separating units or lithologies are interpreted as Alpine contacts (*e.g.* Cohen et al., 1981, Péquignot and Potdevin, 1984, Jolivet et al., 1990, Jolivet et al., 1991, Fournier et al., 1991, Rossi et al., 1994a, Rossi et al., 1994b, Daniel et al., 1996 and Rossi et al., 2001), lithostratigraphic reconstructions of several terranes are proposed based on local observations of preserved primary stratigraphic successions (Caron and Delcey, 1979, Rieuf, 1980, Faure and Malavieille, 1981, Durand-Delga, 1984, Libourel, 1985, Libourel, 1988, Vitale Brovarone et al., 2011a and Meresse et al., 2012). However, assessing precise paleogeographic locations within the Western Tethys basin is still matter of debate. Before the relevant development of the study of modern and fossil OCT (*e.g.* Mohn et al., 2010 and ref. therein), the association of ophiolites with continental basement slivers was enigmatic. Some authors considered the continental slivers (“Internal Continental units”) as derived from a continental micro-block separated from the Corsica margin (*e.g.* Lahondère, 1996). Other authors considered these continental slices as fragments of the thinned European margin associated with ophiolitic rocks during the Alpine orogeny (*e.g.* Sauvage-Rosemberg, 1977, Durand-Delga, 1978, Mattauer et al., 1981 and Péquignot and Potdevin, 1984). By analogy with recent works defining the modern concept of Ocean-Continent Transition (OCT) zone (*e.g.* Florineth and Froitzheim, 1994, Manatschal et al., 2006 and Péron-Pinvidic and Manatschal, 2009), some authors have interpreted these terranes as fossil OCT zones originating from the Corsica margin (*e.g.* Lahondère, 1996, Rossi et al., 2002, Vitale Brovarone et al., 2011a, Vitale Brovarone et al., 2011c and Meresse et al., 2012).

The origin of the *Castagniccia* and *Bagliacone-Riventosa* metasedimentary formations is still unclear and may derive from a variety of paleogeographic locations. The *Castagniccia* formation has been considered either as the stratigraphic cover of the Santo Pietro di Tenda formation (Caron and Delcey, 1979), or as the cover of a continental margin (Caron et al., 1979), or as a more eastern (closer to the Adria margin) oceanic sedimentary formation (Lahondère, 1996). The *Bagliacone-Riventosa* formation has been interpreted either as a Liassic continental cover or as the Cretaceous cover of the continental Santa Lucia unit (Amaudric Du Chaffaut et al., 1972, Durand-Delga, 1978 and Durand-Delga, 1984).

Authors generally agree on the paleo-position of the Inzecca (s.l.) formation, which has been attributed to a distal oceanic domain. However, along the eastern border of the Tenda unit, the Inzecca rocks contain continent-derived material (*Santo Pietro di Tenda formation s.s.*), which suggests a position closer to a continental source (*e.g.* Caron and Delcey, 1979). The Tenda unit has been considered either as a slice of continental basement within the SL complex (*e.g.* Molli, 2008), or as an independent unit (*e.g.* Lahondère, 1996 and Malasoma and Marroni, 2007). In both cases it is interpreted to belong to the Corsica hyper-extended margin. Differently, the Upper External Continental units have been referred to the Corsica margin (*e.g.* Durand-Delga, 1984, Libourel, 1985, Lahondère, 1996, Peybernès et al., 2001 and Rossi et al., 2002), to the Adria margin (Dallan and Nardi, 1984 and Argnani, 2009), or to a continental micro-block (*e.g.* "Alkapeca" in Molli, 2008 and Lustrino et al., 2009). In a similar way, the Nappes Supérieures, in particular the Balagne and Nebbio units, were interpreted by some authors as derived from an OCT paleo-position close to the European margin (Lahondère, 1996, Durand-Delga et al., 1997, Rossi et al., 2002 and Marroni and Pandolfi, 2007). Some of these authors also separate the Balagne domain and the Piemonte-Liguria basin by means of a continental micro-block including the so-called "Internal Continental units" (*e.g.* Serra di Pigno, Farinole, Centuri). Some other authors favor an occurrence close to a continental microblock representing the backstop of subduction (cf. Section 3 ; Molli, 2008 and Molli and Malavieille, 2010). A paleo-position proximal to the European continent is also proposed for the Pineto unit (Padoa and Durand-Delga, 2002), while the Rio Magno unit is considered to belong to more distal domains (Durand-Delga et al., 2005).

The timing of Alpine H*P* metamorphism, albeit constrained by both biostratigraphy and geochronology, is still a matter of debate. Biochronological constraints are limited to a few occurrences. Bartonian nummulites are found in a low-grade blueschist metaconglomerate in the Corte area, suggesting that the metamorphism in the External Continental units is younger than 40 Ma (Bezert and Caby, 1988 and Bezert and Caby, 1989). To the south of Corte, unmetamorphosed Priabonian sediments lay primarily onto autochtonous Hercynian basement rocks metamorphosed under greenschist facies conditions during the Alpine orogeny, pointing to a pre-Priabonian metamorphism (Ferrandini et al., 2010). Other authors consider this greenschist deformation as post-depositional, thus post-Priabonian (Bezert and Caby, 1989). These observations constrain the Alpine metamorphism in the more external (European) units to a Middle- to Upper Eocene age comprised between a maximum of ~ 40 Ma and a minimum of ~ 34 Ma. On the other hand, Eocene sediments resting unconformably upon both the Hercynian Corsica and the Schistes Lustrés complex are used to constrain the Alpine metamorphism to a pre-Eocene age (Amaudric du Chaffaut, 1982 and Egal, 1992). A similar conclusion is supported by the occurrence of detrital H*P* mineral (phengite) in poorly metamorphosed Eocene sediments in the Corte area (Amaudric du Chaffaut and Saliot, 1979).

The Santa Lucia unit (External Continental units) overlies Upper Lutetian, *nummulite*-bearing sedimentary cover of the Caporalino unit, indicating a post-Middle Eocene tectonics (Rossi et al., 1994a and Ferrandini et al., 2010).

Sediments of the foreland basin (Annunciata formation) contain Upper Lutetian *nummulites* reworked during the overthrusting of the Balagne unit, thus constraining the nappe emplacement to be younger than 41 Ma (*e.g.* Nardi et al., 1978). Finally, post-metamorphic Miocene sediments overlaying the H*P* units are also documented in the Saint Florent, Francardo, Bonifacio and Aleria basins (Durand-Delga, 1978 and references therein), also constraining the timing of emplacement of the Nappes Supérieures between Middle Eocene (Lutetian) and Miocene (*e.g.* Dallan and Puccinelli, 1995 and Ferrandini et al., 1998).

These biostratigraphic constraints often mismatch with most of the published geochronological data in the SL complex, ranging from Late Cretaceous to Oligocene. Pre-Eocene ages for the H*P* metamorphism are limited to a few cases: a two-step discordant Ar–Ar on a glaucophane of about 90 Ma from the eclogitic Sant'Andra di Cotone area (Maluski, 1977), a Rb–Sr whole-rock age of

105 ± 8 Ma from the East Tenda Shear Zone (Cohen et al., 1981) and a whole rock Sm–Nd age of 83.8 ± 4.9 Ma from the eclogitic Volpajola area (Lahondère and Guerrot, 1997). A Late Cretaceous age of about 65 Ma is commonly cited in the literature (e.g. Jolivet et al., 2003, Molli, 2008, Molli and Malavieille, 2010, Ravna et al., 2010 and Martin et al., 2011) after Brunet et al. (2000) . However, Brunet et al. (2000) interpret that age as affected by excess Ar, and thus as not representative. Ar–Ar dates on H*P* phengite from different units range between 44 and 25 Ma and are interpreted as progressive retrograde resets (Maluski, 1977, Amaudric du Chaffaut and Saliot, 1979, Jourdan, 1988, Lahondère, 1996 and Brunet et al., 2000). An Early Eocene age (55 Ma) has been recently proposed for the overthrusting of ophiolitic material of the SL complex onto the Tenda continental basement unit (Maggi et al., 2012). Recently, U–Pb on zircon data point to a Late Eocene metamorphism in the eclogitic unit of the SL complex (Martin et al., 2011). Similarly, Lu–Hf on garnet and lawsonite shows Late Eocene ages at around ~ 34 Ma for the eclogitic unit in the SL complex and ~ 37 Ma in the lawsonite blueschist unit (Herwartz et al., 2012, Vitale Brovarone et al., 2012 and Vitale Brovarone and Herwartz, submitted for publication). These latter authors discuss in detail the untenability of pre-Eocene geochronological estimates in the H*P* units of the SL complex. In the Saint Florent and Francardo Miocene basins, the sediments are tilted westward parallel to the western limb of the Schistes Lustrés antiform, indicating that they deposited prior to or during the tilting of the antiformal structure (*e.g.* Cavazza et al., 2001). Zircon fission tracks indicate heterogeneous timings (possibly affected by partial resetting) of exhumation ranging from Late Eocene to Miocene (Fellin et al., 2006). The only exception is the Cretaceous age from the Santa Lucia unit (cf. Fellin et al., 2006). Fission tracks and (U–Th)/He ages on apatite indicate the exhumation of the Alpine units at shallow depth starting from the Middle Miocene (Cavazza et al., 2001, Zattin et al., 2001, Zarki-Jakni et al., 2004, Fellin et al., 2005a, Fellin et al., 2005b and Danisik et al., 2007).

Several conceptual models have been proposed for the evolution of Alpine Corsica. All models imply a Cretaceous age for the H*P* metamorphism on the distal domain of the basin, and a late Eocene–Oligocene blueschist-to-greenschist retrogression (*e.g.* Jolivet et al., 1990, Malavieille et al., 1998, Molli et al., 2006 and Molli and Malavieille, 2010). However, an ongoing discussion regards the attribution of Alpine Corsica to the Alpine subduction, to the Apennine, or to a complex flip from one subduction system to the other (*e.g.* Elter and Pertusati, 1973, Mattauer et al., 1981, Principi and Treves, 1984, Warburton, 1986, Jolivet et al., 1998, Molli and Tribuzio, 2004, Molli, 2008 and Molli and Malavieille, 2010). Principi and Treves (1984) interpreted Alpine Corsica as the result of a long-lived, Cretaceous-to-present west-dipping subduction (*i.e.* the Apenninic) that progressively migrated toward the east. This interpretation was progressively accepted by many authors (*e.g.* Lahondère, 1996 ; Lahondère et al., 1998; Durand-Delga and Rossi, 2002 and Rossetti et al., 2002; see also the review by Molli, 2008 and references therein). On the other hand, mostly based on the occurrence of top-to-the-west kinematic criteria in the HP units, other authors interpreted Alpine Corsica as the result of a Late Cretaceous east-dipping subduction (*i.e.* Alpine), followed by a Eocene continental collision (*e.g.* Mattauer et al., 1981, Gibbons and Horak, 1984, Warburton, 1986, Jolivet et al., 1990, Fournier et al., 1991, Daniel et al., 1996, Finetti et al., 2001 and Molli et al., 2006). A similar east-dipping subduction was also proposed by Malavieille et al. (1998) , but the authors proposed the development of an Early Cretaceous proto-Corsica belt, followed by a second Late Cretaceous–Eocene subduction system.

A fourth model involves first a Late Cretaceous, east-dipping intraoceanic subduction and Eocene continental collision followed by a Late Eocene/Oligocene-onward west-dipping Apenninic subduction (e.g. Elter and Pertusati, 1973, Doglioni et al., 1998, Molli and Tribuzio, 2004, Molli, 2008, Molli and Malavieille, 2010, Vitale Brovarone, 2011, Argnani, 2012 and Turco et al., 2012).

There is a large consensus regarding the Oligo-Miocene top-to-the-east extensional tectonics reworking the Alpine Corsica tectonic stack in response to the opening of the Tyrrhenian basin (*e.g.* Durand-Delga, 1978, Jolivet et al., 1990, Jolivet et al., 1991, Fournier et al., 1991, Jolivet et al., 1998, Brunet et al., 2000, Faccenna et al., 2001, Loye-Pilot et al., 2004, Molli, 2008 and Molli and Malavieille, 2010). This extensional phase was the core of most of the recent research effort on Alpine Corsica and its relationships with the Apennines.

4. RSCM method and sampling strategy

Beyssac et al., 2002a and Beyssac et al., 2002b calibrated a technique for the quantification of peak metamorphic *T* even in the absence of specific mineral assemblages necessary for the classical thermobarometric estimates. The technique, Raman Spectroscopy of Carbonaceous Material (RSCM), is based upon the observation that sedimentary carbonaceous material is progressively transformed into graphite with increasing metamorphism. Beyssac et al., 2002a and Beyssac et al., 2002b found a linear relationship between *T* and the structural state of CM quantified by Raman microspectroscopy. Because of the irreversible character of graphitization, CM structure is not sensitive to the retrograde path during exhumation of rocks, but only depends on the maximum *T* reached during metamorphism (Beyssac et al., 2002a). *T* can be determined in the range 330–650 °C with a calibration-attached accuracy of ± 50 °C due to uncertainties on petrologic data used for the calibration. Relative uncertainties on *T* are, however, much smaller, around 10–15 °C (Beyssac et al., 2004).

Lahfid et al. (2010) investigated the applicability of RSCM thermometry at lower *T* in the range 200–350 °C, based on a qualitative comparison of Raman spectra with *T* data in the Glarus Alps of Central Switzerland. Although elaboration of the definitive version of the quantitative correlation is still in progress, we used their qualitative calibration as a first approximation to determine *T* values in the low-grade rocks ($T < 330$ °C). Raman spectra were obtained using a Renishaw InVIA Reflex microspectrometer (IMPMC Paris). We used a 514 nm Laser Physics argon laser in circular polarization. The laser was focused on the sample by a DMLM Leica microscope with a 100 × objective (NA = 0.85), and the laser power at the sample surface was set around 1 mW. The Rayleigh diffusion was eliminated by edge filters, and to achieve nearly confocal configuration the entrance slit was closed down to 15 μm. The signal was finally dispersed using a 1800 g/mm grating and analyzed by a Peltier cooled RENCAM CCD detector. Before each session, the spectrometer was calibrated with a silicon standard. Because Raman spectroscopy of CM can be affected by several analytical mismatches, we followed closely the analytical and fitting procedures described by Beyssac et al., 2002a, Beyssac et al., 2002b and Beyssac et al., 2003. Measurements were done on polished thin sections cut perpendicularly to the main fabrics (S0, S1), and CM was systematically analyzed below a transparent adjacent mineral, generally quartz, to avoid polishing-induced damages. 10–20 spectra were recorded for each sample in the extended scanning mode (70000–2000 cm^{-1}) with acquisition times from 30 to 60 s. Spectra were then processed using the software Peakfit (Beyssac et al., 2003).

H*P*-L*T* mineral assemblages are widely preserved in Alpine Corsica such as in the western Alps. In particular, the widespread preservation of lawsonite suggests a cold exhumation path and the absence of a retrograde heating as observed in many collisional belts. Consequently, in this particular case, the RSCM-*T* may record the actual peak of metamorphism (*i.e. P* and *T*), as observed in a similar geodynamic context in the Western Alps (Gabalda et al., 2009).

More than one hundred samples, consisting of carbon-bearing metasediments, including calcschist, micaschist, impure marble, meta-pelite, and impure quartzite, were collected along eleven representative geologic cross-sections and as single isolated samples covering all the major tectono-metamorphic units of Alpine Corsica (Fig. 3 and Fig. 4). Special attention was paid to the sampling of Mesozoic-to-Eocene metasediments, following previous lithostratigraphic constraints (cf. Section 2.1.1), and to the metasediment-rich SL nappe, which will be presented first. In order to check the consistency of the data within the different tectonic units and their characteristic clusters of RSCM-*T*, a high-density sampling was performed along the Golo valley cross-section (cross-section G in Fig. 3 and Fig. 4).

5. Results

Metasediments of Alpine Corsica show significant variations in the structural organization of CM (Fig. 5 , Table 1). As a general overview, from the lowermost toward the uppermost overlying units the CM spectra exhibit increasing D1 and D2 defect bands relatively to the G graphite band and, locally, the appearance of the D3 defect band (Fig. 5), *i.e.* increasing structural disorder within the graphitic structure (*e.g.* Beyssac et al., 2003). Such evolution can be interpreted as due to a general *T* decrease (*e.g.* Beyssac et al., 2002a). The reader interested in the graphitization process during H*P* metamorphism in terms of physico-chemical transformation of CM should refer to Beyssac et al. (2002b) . In the uppermost units spectra characteristic of very-low *T* were observed. These spectra, characterized by a prominent D3 band, a very large D1 band and the appearance of a D4 shoulder, appear to correspond to *T* below the lower boundary of the calibration proposed by Beyssac et al., 2002a and Beyssac et al., 2002b, *i.e.* 330 °C. For these samples, the RA1 correlation proposed by Lahfid et al. (2010) for very-low *T* CM was used. A more detailed description of the *T* distribution across the belt is presented in the following sections.

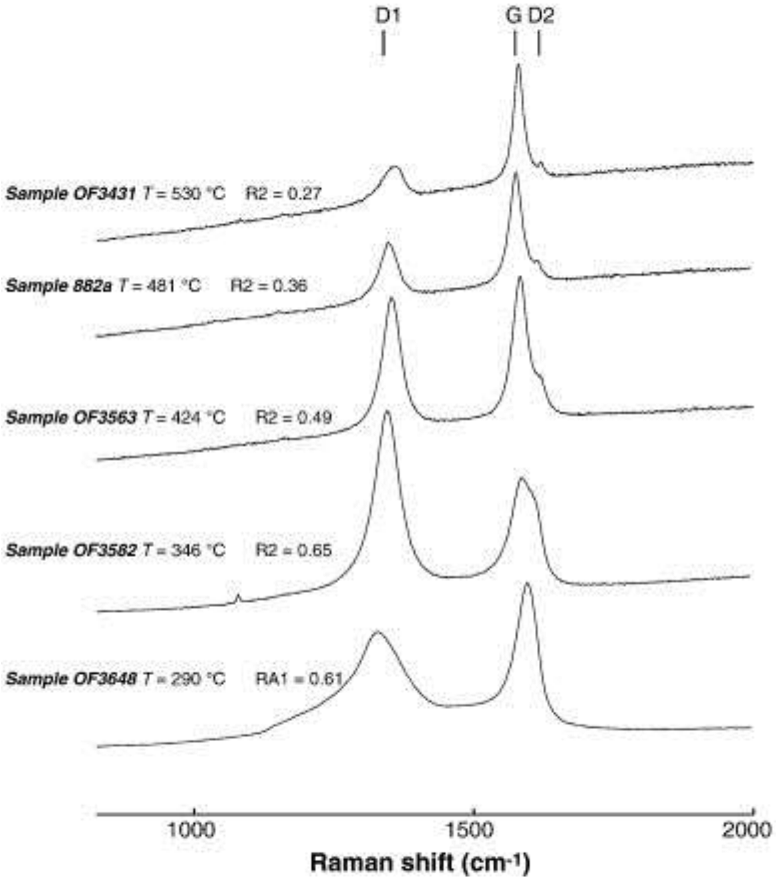


Fig. 5.

Representative Raman spectra of carbonaceous material (CM) obtained in various units of Alpine Corsica. For each spectrum, R2 or RA1 ratio and corresponding RSCM-T, calculated from the depicted CM spectrum, are indicated. See Beyssac et al. (2002a) and Lahfid et al. (2010) for details regarding RSCM thermometry.

Table 1.

Selected samples for RSCM thermometry. GPS coordinates in WGS84 system, number of spectra (n), mean R2ratio (Beyssac et al., 2002a) or RA1 ratio (Lahfid et al., 2010) for n spectra with corresponding standard deviation (sdv), and calculated temperature with standard error (SE). Standard error is the standard deviation divided by √n. The absolute error on temperature is ± 50 C (Beyssac et al., 2002a). *low-T samples processed with RA1 ratio.

	Locality	**Latitude**	**Longitude**	**n.**	**R2/RA1**	**SD**	***T* *(°C)***	**SE (°C)**
Cross-section A								
OF3577	West Macinaggio	42.97181637	9.440072505	12	0.27	0.09	***507***	5
co736	Macinaggio	42.95228364	9.456323825	12	0.38	0.09	***461***	8
OF3641*	Macinaggio (flysch)	42.96807984	9.456023655	17	0.58	0.01	***256***	3
OF3571	Centuri	42.97292407	9.351502755	14	0.43	0.04	***448***	4
Cross-section B								
OF3573	Cap Corsev1	42.9396355	9.370396977	13	0.42	0.05	***453***	6
OF3574	Cap Corsev2	42.93166556	9.40506788	13	0.57	0.02	***385***	2
OF3575	Cap Corsev3	42.93031896	9.428649581	14	0.52	0.16	***378***	6
OF3576	Cap Corsev4	42.93115628	9.447515805	13	0.39	0.05	***466***	6
Cross-section C								
OF3570	Marina d'Albo	42.81300724	9.337079797	14	0.38	0.03	***474***	4
0727B	Sisco	42.82087126	9.428027301	14	0.46	0.03	***435***	3
0728B	Sisco	42.82225498	9.428856487	13	0.45	0.02	***441***	3
c0734	Erbalunga	42.77287804	9.470247442	14	0.31	0.04	***503***	4
c0607	Porticciolo	42.86459522	9.481642304	15	0.35	0.10	***470***	8
M12-1	Albo	42.80815998	9.33806544	13	0.42	0.05	***441***	6
Cross-section D								
Far0602	Farinole	42.73026144	9.361941616	15	0.38	0.04	***473***	5

	Locality	Latitude	Longitude	n.	R2/RA1	SD	*T* *(°C)*	SE (°C)
OF3644	Bracolaccia	42.7306267	9.377127525	17	0.47	0.03	***433***	3
OF3643	East of Bracolaccia	42.73165393	9.368643882	18	0.44	0.03	***447***	3
OF3653	M.te Pinatelle	42.73634148	9.396879671	20	0.45	0.03	***442***	3
c0734	Erbalunga	42.77287804	9.470247442	14	0.31	0.04	***503***	4
Cross-section E								
OF3648*	East of Lozari (Eoc)	42.64821314	9.026179734	17	0.61	0.01	***290***	3
OF3647*	Punta d'Arco (Eoc)	42.65246032	9.038515864	17	0.61	0.01	***289***	2
c0615*	Balagne	42.65815242	9.058505039	13	0.59	0.01	***273***	3
OF3640*	Ostriconi	42.65657802	9.055306914	13	0.60	0.00	***281***	1
c0702*	Volparone	42.54780461	9.075246473	13	0.62	0.01	***306***	2
c0704	East Tenda	42.70017486	9.262503833	14	0.63	0.02	***360***	2
OF3642	Santo Pietro di Tenda (Eoc?)	42.61176078	9.268911091	17	0.63	0.02	***362***	2
OF3650*	Nebbio (Cret)	42.62826574	9.325410272	10	0.60	0.01	***276***	3
OF3649*	Nebbio (Cret)	42.62826574	9.325410272	13	0.62	0.01	***307***	2
OF3601	East Nebbio	42.69122694	9.360518527	14	0.65	0.02	***352***	2
c0613	Pigno	42.68671157	9.394402976	14	0.48	0.03	***427***	3
c0742	Teghime	42.67730503	9.385201951	13	0.51	0.04	***414***	5
c0614	Pigno	42.68731606	9.394077213	13	0.47	0.02	***430***	2
c0709	Pigno	42.71732818	9.407896576	13	0.52	0.03	***411***	4
Cross-section F								
o4-9	Oletta			13	0.65	0.01	***353***	1
OF3579	West of Zucarello	42.62251191	9.375218323	15	0.39	0.06	***465***	7
OF3578	Zuccarello	42.44181418	9.282883619	15	0.46	0.04	***435***	5

	Locality	Latitude	Longitude	n.	R2/RA1	SD	*T* (°C)	SE (°C)
c0716a	Défilé de Lancône	42.61236296	9.414294658	13	0.67	0.01	***343***	1
Cross-section G								
OF3405	Golo Valley	42.48140592	9.206106573	12	0.65	0.04	***357***	3
OF3407	Golo Valley	42.47895471	9.211926224	13	0.66	0.01	***347***	2
OF3412	Golo Valley	42.48771539	9.260944458	14	0.66	0.01	***346***	2
OF3413	Golo Valley	42.48840601	9.266094479	13	0.64	0.01	***356***	2
OF3414	Golo Valley	42.50901643	9.279145275	13	0.66	0.02	***346***	3
OF3415	Golo Valley	42.51734485	9.27624845	13	0.67	0.02	***344***	2
OF3416	Golo Valley	42.48634322	9.292161341	13	0.60	0.03	***374***	4
OF3417	Golo Valley	42.48515797	9.297789412	12	0.56	0.03	***390***	4
OF3418	Golo Valley	42.48514773	9.294783973	12	0.62	0.01	***364***	2
OF3419	Golo Valley	42.48526781	9.297108547	14	0.54	0.04	***402***	5
OF3420	Golo Valley	42.48526781	9.297108547	11	0.56	0.06	***386***	7
OF3421	Golo Valley	42.48597632	9.301686967	29	0.49	0.05	***421***	4
OF3693	Pastoreccia	42.46396663	9.31480296	14	0.35	0.05	***487***	6
OF3423	Golo Valley	42.48392383	9.308137959	12	0.28	0.05	***516***	7
OF3424	Golo Valley	42.48349701	9.309449927	12	0.29	0.08	***526***	7
OF3425	Golo Valley	42.48349701	9.309449927	12	0.27	0.07	***520***	7
OF3426	Golo Valley	42.4809268	9.314060627	13	0.23	0.07	***542***	8
OF3427	Golo Valley	42.48215986	9.314334468	14	0.29	0.06	***512***	7
OF3429	Golo Valley	42.47982946	9.31682911	12	0.22	0.09	***546***	7
OF3430	Golo Valley	42.47836635	9.318330345	14	0.28	0.10	***518***	8
OF3431	Golo Valley	42.47828946	9.320069727	14	0.27	0.08	***530***	7
OF3432	Golo Valley	42.48157901	9.319210478	12	0.24	0.06	***533***	8

	Locality	Latitude	Longitude	n.	R2/RA1	SD	*T* *(°C)*	SE (°C)
OF3436	Golo Valley	42.49390185	9.357898379	14	0.28	0.07	***512***	7
OF3439	Golo Valley	42.49927815	9.355069017	13	0.26	0.05	***525***	7
OF3440	Golo Valley	42.50070487	9.365324717	12	0.28	0.07	***521***	8
OF3441	Golo Valley	42.50665546	9.374402962	13	0.29	0.06	***511***	7
OF3442	Golo Valley	42.5037445	9.385887345	13	0.27	0.06	***520***	8
OF3443	Golo Valley	42.51002725	9.402565638	13	0.34	0.05	***492***	7
OF3444	Golo Valley	42.51348768	9.42684874	13	0.30	0.06	***506***	8
Cross-section H								
OF3595	Lento Ar	42.44185939	9.282810867	16	0.64	0.02	***357***	2
OF3132	Campitello	42.43923081	9.300064377	15	0.49	0.05	***422***	6
OF3593	Morosaglia	42.43219962	9.299119036	13	0.45	0.02	***441***	2
OF3691	Morosaglia	42.43613052	9.311040492	13	0.34	0.03	***490***	3
0707a	Prato	42.44197899	9.32910153	13	0.20	0.05	***552***	6
OF3591	Castagniccia	42.42253538	9.338286588	13	0.26	0.07	***532***	7
OF3568	La Porta	42.42735378	9.356060812	14	0.37	0.03	***475***	4
882a	Nocario	42.39738572	9.348929053	14	0.36	0.06	***481***	8
OF3567		42.43415501	9.372524354	14	0.34	0.05	***492***	6
OF3566	Casette	42.43086906	9.445386428	11	0.29	0.04	***513***	5
OF3565	Pero Casevecchie	42.41695592	9.465512811	13	0.48	0.04	***428***	5
OF3564	Talasani	42.40399745	9.478358722	14	0.50	0.07	***418***	6
OF3563	Figareto	42.41065959	9.520240435	17	0.49	0.03	***424***	3
Cross-section I								
OF3582	Corte	42.29404312	9.161751163	13	0.65	0.01	***346***	2
v137*	Tralonca	42.34044288	9.211545445	12	0.62	0.01	***302***	4

	Locality	Latitude	Longitude	n.	R2/RA1	SD	*T* *(°C)*	SE (°C)
v80*	Tralonca	42.34044288	9.211545445	13	0.61	0.01	***298***	2
of3558*	Tralonca	42.33466616	9.213589634	12	0.62	0.01	***301***	5
OF3580*	Caporalino	42.38152115	9.190133532	15	0.59	0.01	***272***	4
OF3557*	M. Piano Maggiore	42.32581652	9.251851378	13	0.61	0.01	***310***	5
OF3556	Sermano	42.31282438	9.262235095	13	0.55	0.04	**398**	4
OF3555	Bustanico	42.32776302	9.300019534	13	0.63	0.01	***361***	2
OF3554	W of Bustanico	42.33219723	9.325275601	17	0.42	0.04	***452***	4
OF3552	M.te Muffraje	42.33856168	9.341744966	13	0.28	0.09	***510***	6
OF3569	Favalta	42.38164747	9.322870409	13	0.20	0.06	***544***	7
OF3553	E of M.te Muffraje	42.33084633	9.322076403	12	0.30	0.07	***510***	9
881a	Piobetta	42.34557833	9.381446347	15	0.35	0.07	***487***	8
OF3559	Perelli	42.32188276	9.39226204	13	0.39	0.05	***470***	6
OF3560	Castagneto	42.32767768	9.406632032	13	0.28	0.07	***514***	8
881a-1	Ortale	42.31737272	9.422122984	13	0.49	0.05	***444***	6
OF3561	Cotone	42.30738797	9.465541869	13	0.28	0.05	***519***	7
OF3562	Careggia	42.31520659	9.49532964	14	0.49	0.04	***425***	4
Cross-section J								
co3*	Corte			5	0.63	0.02	***313***	10
OF3583	Tav 1	42.28089644	9.205282044	14	0.63	0.03	***361***	3
OF3584	Tav 2	42.24930881	9.211737676	13	0.65	0.01	***351***	1
OF3585	Tav 3a-b	42.21850466	9.276456691	14	0.67	0.02	***342***	2
OF3586	Tav 4	42.21228972	9.340324406	13	0.63	0.03	***360***	4
861a	Tavignano			12	0.67	0.01	***342***	2
Cross-section K								

	Locality	**Latitude**	**Longitude**	**n.**	**R2/RA1**	**SD**	***T* *(°C)***	**SE (°C)**
OF3717*	Eocene Prunelli	41.99793173	9.34154647	14	0.63	0.01	***318***	3
OF3718*	Eocene Prunelli	41.99793173	9.34154647	13	0.64	0.01	***326***	3
OF3719*	Eocene Prunelli	41.96701016	9.348091326	12	0.63	0.01	***305***	3
OF3720*	SL Prunelli	41.96564242	9.370699706	15	0.61	0.01	***296***	3
OF3721*	SL Prunelli	41.96564242	9.370699706	18	0.61	0.00	***298***	1
INZECCA*	Défilé Inzecca			15	0.62	0.01	**307**	2

5.1. The SL complex

Owing to the detailed lithostratigraphic subdivision proposed in the past (*e.g.* Caron and Delcey, 1979), results from the SL complex will be presented following the classic metasedimentary formations (cf. Section 2.2.1). Particular attention is given to the SAC region, and, especially, to the well-known Golo valley (cross-section G in Fig. 3 and Fig. 4), representing a natural cross-section through the whole SL complex. There, a dense sampling was performed in order to check the possible variation of RSCM-*T* within the whole metasedimentary sequence (cf. Section 2.2.2), and to define the resulting representative clusters of RSCM-*T*. As mentioned above, compared to the SAC and the CAD, the NAC represents a portion of the belt which is less known from a tectono-metamorphic point of view. For this reason, this region is presented separately.

5.1.1. The SAC and CAD regions

In the SAC and CAD, five different clusters of RSCM-*T* are observed and presented from the lowermost to the uppermost structural position, *i.e.* (Fig. 3 and Fig. 4):

1. In the lowermost structural position, coinciding with the *Lower Castagniccia* sequence, samples yield RSCM-*T* ranging from 444 °C (sample 881a) to 492 °C (sample OF3567) (cross-sections H and I). These rocks are locally characterized by the occurrence of lawsonite and chloritoid. Fully retrogressed carpholite was observed only in sample OF3559 (cf. Table 1 for location). Garnet was observed only in Mn-rich metachert.

2. RSCM-*T* comprised between 487 and 552 °C characterize the second structural level of the SL complex, coinciding with part of the *Upper Castagniccia* sequence and part of the *Santo Pietro di Tenda* sequence. These rocks yield homogeneous RSCM-*T* over 500 °C and are observed on both sides of the SL antiform along the G, H, and I cross-sections. The only exceptions are two samples located along the western margin of the SL antiform along the G and H cross sections, which show a slightly lower RSCM-*T* of about 490 °C (samples OF3691 = 490 °C and OF3693 = 487 °C). They are especially well exposed in the Golo Valley (cross-section G), forming a rather continuous metasedimentary body associated with eclogitic ophiolites and continental basement slivers. Variably retrogressed lawsonite, chloritoid and blue-amphibole are commonly observed in these samples. Garnet, which is relatively abundant in metamafics, is rare in metasediments and almost restricted to Mn-rich metachert and marble.

3. A cluster ranging from 364 to 466 °C is observed in the third structural position. These rocks belong to the *Upper Castagniccia*, the Inzecca (s.l.) and *Santo Pietro di Tenda* metasediments and are associated with blueschist-facies ophiolites and continental basement slivers. In the SAC, these samples yield homogeneous RSCM-*T* at about 440 °C on the eastern limb of the SL antiform. On the contrary, on the western limb these rocks show heterogeneous RSCM-*T* decreasing toward the overlying unit and comprised between 364 °C and 420 °C (cross-sections G, H and I, Fig. 3 and Fig. 4). In the CAD, RSCM-*T* from the autochthonous cover of the Serra di Pigno continental sliver range from 411 to 430 °C. As in the previous cluster, variably retrogressed lawsonite, chloritoid and blue-amphibole are commonly observed. Garnet was observed only in Mn-rich metachert and in local metasomatic rocks (e.g. Chopin et al., 2008). Titanite appears to be more common than in the other clusters.

4. RSCM-*T* around 350 °C (342–361 °C) are observed in the area coinciding with both the *Inzecca* (s.l.) and *Bagliacone-Riventosa* metasedimentary sequences. This cluster is well observed along the E, F, G, H, I and L cross-sections. In the F profile, these temperatures are observed on both sides of the antiform in the Oletta (to the West) and Biguglia (to the East) areas. With the exception of epidote, no diagnostic minerals are observed in these rocks.

5. RSCM-*T* comprised between 296 and 326 °C are observed in the Monte Piano Maggiore sequence (cross-section I), in the Inzecca area (s.s.) and in the southernmost termination of Alpine Corsica (Table 1) regions.

5.1.2. The NAC region

In this region, two main clusters of RSCM-*T* were recognized (Fig. 3 and Fig. 4):

1. In the lowermost structural position, coinciding with the *Lower Castagniccia* sequence, RSCM-*T* at about 380 °C (samples OF3574 = 385 °C; OF3575 = 378 °C) is observed (cross-section A and B).

2. In a higher structural position, a heterogeneous cluster is found with RSCM-*T* ranging from 435 °C (sample co727b) to 507 °C (sample OF3577) (cross-sections A, B, C, D). No specific geometrical or microstructural features associated to these *T* can be defined in order to distinguish subdivisions in this cluster. Most of these samples are closely associated with eclogites (Fig. 3 and Fig. 4). In particular, close to the Albo village, metasediments in contact with mafic eclogites yield a RSCM-*T* of 441 °C (sample M12-1). Relics of lawsonite were locally observed in these rocks.

5.2. The Tenda unit

Only one sample was analyzed from this unit, mainly because of the scarceness of unambiguous autochthonous metasediments associated with this continental slice. Sample OF3642, belonging to the autochthonous Cretaceous–Eocene (?) cover of the Tenda unit (Lahondère et al., 1999 and Rossi et al., 2001), yields a RSCM-*T* of 362 °C (cross-section E, Fig. 3 and Fig. 4).

5.3. The Lower and Upper External Continental units

These units all yield homogeneous RSCM-*T* of about 300 °C. More specifically, a sample from the Annunciata-Volparone slices yields a RSCM-*T* of 306 °C (from the Volparone breccia, cross-section E in Fig. 3 and Fig. 4), a sample from the Corte slice yields a RSCM-*T* of 313 °C (cross-section L), the Caporalino unit yields a RSCM-*T* of 272 °C (from the Caporalino Jurassic carbonates, cross-section I) and the Santa Lucia unit shows an average *T* of 293 °C (samples OF3558, v80, v137, cross-section I) in the Cretaceous Tralonca Flysch. Despite the observed RSCM-*T* similarities, the two units (Lower and Upper External Continental units) show different *P* evolutions (cf. section 2.1.2).

5.4. The "Nappes supérieures"

Four samples from the Balagne nappe were analyzed and yield homogeneous RSCM-*T* at 273 °C (sample co615), 281 °C (sample OF3640, from the cretaceous Ostriconi flysch), 289 °C and 290 °C (sample OF3647 and OF3648, from the Eocene cover). In the Nebbio unit, samples from the Cretaceous cover yield RSCM-*T* of 276 °C (sample OF3650) and 307 °C (sample OF3649). One sample from the Macinaggio flysch yields RSCM-*T* at about 256 °C (sample OF3641). Toward the south, Eocene sediments considered to rest unconformably on top of both the autochthonous Hercynian basement and the SL complex yield RSCM-*T* of 318 °C (sample OF3717) and 326 °C (OF 3718), respectively.

6. Discussion

6.1. Age of RSCM-*T* and comparison with conventional thermobarometry

As H*P* mineral assemblages in mountain belts are commonly affected by a late intense tectono-metamorphic overprint, many obstacles are encountered in distinguishing between units corresponding to homogeneous domains or units deriving from strong, subduction-related mixing. Such difficulty is mostly related to inhomogeneous metamorphic reequilibrations occurring during subduction and exhumation (*e.g.* Fitzherbert et al., 2005 and references therein). Despite the fact that fresh H*P* mineral assemblages are common, lower grade mineral assemblages are largely observed within these terranes, suggesting either heterogeneous retrogression of H*P* mineralogy during exhumation (*e.g.* Klemd et al., 1991 and Fitzherbert et al., 2005), or late tectonic juxtaposition (*e.g.* Bousquet, 2008). This is especially evident in ocean-derived terranes, in which fresh H*P* metamafics are enclosed in poorly diagnostic and highly retrogressed metasediments. Therefore, conventional petrological or geochronological approaches may be seriously limited in such ensembles because of the lack of index mineral assemblages and of the extent of retrogression. As a result, linking lithostratigraphy and petrology in H*P* terranes has represented a major challenge in mountain belts. In this frame, the RSCM thermometry provides a powerful tool to quantify the degree of thermal metamorphism in CM-bearing rocks, and to compare maximum *T* acquired by metasediments with petrological estimates on metamafics. This thermometer can be applied quantitatively from the low-grade units to the eclogite terranes, in particular it provides a quantitative insight into the thermal evolution of very low-grade domains. Consisting of variably subducted domains generally rich in metasediments, Alpine Corsica gives the opportunity to investigate the thermal structure of the entire belt by means of a single geothermometer, the RSCM thermometry. In addition, in Alpine Corsica primary lithostratigraphic features are exceptionally well preserved and documented from many decades (cf. Section 2). This allows for a precise comparison between the petrology and lithostratigraphy of a given unit, and, in turn, it permits a safe and reliable comparison among *P*–*T* estimates of associated rock-types. Since this study focuses on the Alpine metamorphism, only mono-metamorphic rocks were considered, *i.e.* Mesozoic to Eocene sediments. The obtained RSCM-*T*, therefore, must have been acquired during the Alpine orogeny. The only exception may be represented by the very low-grade samples (*i.e.* Nappes Supérieures) for which peak *T* may have been acquired either during burial metamorphism in the Tethys basin prior to orogeny or during the Alpine orogeny. In the first case, sediments would have recorded different *T* depending on their relative depth in the stratigraphic log. However, in the low-grade units of Alpine Corsica, *T* appears to be relatively constant whatever the stratigraphic age with no major variations between the lowermost Mesozoic metasediments and the uppermost Eocene metasediments (cf. Section 4). This observation suggests that these *T* have rather been acquired during the Alpine orogeny under low geothermal gradients.

Previous petrological studies provided only local *P*–*T* estimates acquired with various techniques, which have evolved since the earliest studies. This is especially evident for the Law-Ecl rocks, for which available petrological estimates are very heterogeneous (*T* from 300 °C to 550 °C, cf. Section 2). RSCM thermometry yields the peak-*T* metamorphic conditions, but provides no information on peak-*P*. Consequently, careful consideration must be taken in interpreting RSCM data as representative of the prograde peak evolution or as the effect of late heating. In the studied case, precise constraints are given by the preservation of H*P* mineral phases that are extremely sensible to heating during retrogression, especially lawsonite. In Alpine Corsica, lawsonite is exceptionally well preserved even in eclogites, indicating a limited or the absence of heating during the retrograde path (e.g. Zack et al., 2004). Consequently, in the case of Alpine Corsica, RSCM-*T* can be reliably referred to peak metamorphism (*P*–*T*) conditions. This is further supported by RSCM-*T* obtained from the Law-Ecl unit in the SAC (over 500 °C), which are comparable with the most recent estimates proposed in the same area by means of pseudosection modeling on metabasalts (Vitale Brovarone et al., 2011b).

Slightly lower RSCM-*T* characterize eclogite facies rocks of the NAC, but the complete lack of previous *P*–*T* estimates in that area does not allow any comparison with conventional thermobarometry to be made. In the CAD, no clear evidence of eclogitic metasediments has been reported. However, petrological estimates on metamafic rocks in this area provide *T* values that are comprised between those obtained for Law-Ecl metasediments from the SAC (average/mean value 524 °C) and those of the NAC (average/mean value 462 °C) (pseudosections of samples COR-1 and COR-4, *T* = 470–490 °C in Ravna et al., 2010). This feature, together with the close association of these sediments with mafic eclogites, suggests that a gradual decrease of *T* characterizes the Law-Ecl unit from the south to the north, supporting the occurrence of a thermal gradient in the Law-Ecl unit decreasing northward.

RSCM-*T* obtained in the Law-Bs unit (at around 400–450 °C) are significantly higher than those previously reported for the Serra di Pigno and Campitello areas by means of traditional petrology (300 ± 50 °C, Lahondère, 1996). In the low-Bs Inzecca (s.l.) unit, our results (average RSCM-*T* = 351 °C, Table 2) are in agreement with those provided for the Lento area by Levi et al. (2007) (*T* < 450 °C, phengite-chlorite thermometer).

Table 2.

Main metamorphic features of the established tectono-metamorphic units, with number of samples per unit (n.) and standard deviation (SD). Pressure estimates from previous studies (cf. section 2).

	Name	***Metamorphism***	***Average T °C***	***SD***	***n.***	***P (other studies)***
Unit 1	"lower" Castagniccia	Law	**475 (SAC + CAD)**	17	6	1.4–1.7 GPa
			382 (NAC)	/	2	/
Unit 2	Law-Ecl	Law-Eclogite	**524 (SAC + CAD)**	13	22	1.9–2.6 GPa
			462 (NAC)	24	15	/
Unit 3	Law-Bs	Law-Blueschist	**423**	18	19	0.8–1.0 GPa
Unit 4	Lower External continental Units	low-grade blueschist	**309**	/	2	0.6 ± 0.15 GPa
Unit 5	Tenda	low-grade blueschist	**362**	/	1	0.8-1.4 GPa
Unit 6	Bagliacone-Riventosa	low-grade blueschist	**355**	/	2	/
Unit 7	Inzecca	low-grade blueschist	**351**	7	16	0.6-1.0 Gpa
Unit 8	Upper External Continental Units	subgreenschist	**293**	/	4	/
Unit 9	Nappes Supérieures	subgreenschist	**288**	18	9	0.3-0.4 Gpa

Table options

RSCM-*T* obtained from the Cretaceous–Eocene (?) cover of the Tenda unit and from the associated low-grade Blueschist Inzecca Unit of the SL complex (OF3642, C0704, ~ 350 °C) are comparable with those previously proposed for the continental basement rocks of the Tenda unit (300–500 °C and 0.8–1.0 GPa: Tribuzio and Giacomini, 2002 and Molli et al., 2006). These results strongly support the idea that the Tenda massif and its autochthonous cover as well as the associated Schistes Lustrés complex underwent a common evolution during the Alpine orogenesis, as already proposed by Molli et al. (2006) based on tectonic arguments.

RSCM-*T* of the Lower and Upper External Continental units, at around 300 °C, are highly similar to those previously proposed (300–350 °C: Zibra, 2006 and Malasoma and Marroni, 2007).

The Nappes Supérieures (~ 300 °C) yield RSCM-*T* higher than those of about 150–200 °C, based on the type of calcite twins (Marroni and Pandolfi, 2003). Importantly, in the Monte Piano Maggiore area, sediments overlying the Caporalino Unit that were previously attributed to the SL complex show very low RSCM-*T* (~ 300 °C, Sample OF3557, Table 1). Similarly, sediments from the Inzecca (s.s.) area yield very low *T* (310 °C, Sample INZECCA, Table 1). For this reason, and for their documented very low-grade metamorphic features (e.g. Péquignot and Potdevin, 1984), these rocks are herein referred to the Nappes Supérieures.

6.2. The thermal architecture of Alpine Corsica: nine tectono-metamorphic units

The obtained RSCM-*T*, ranging from less than 300 °C to nearly 550 °C, are characteristic of low to intermediate *T* metamorphic conditions. Although the whole range of RSCM-*T* among the studied samples is restricted to about 250 °C, several clusters of RSCM-*T* are observed. Thus, despite the relatively loose uncertainty of the RSCM thermometer (± 50 °C), these clusters can be easily distinguished due to the excellent internal consistency of the method (*e.g.* Beyssac et al., 2004, Negro et al., 2006, Beyssac et al., 2007, Celerier et al., 2009 and Gabalda et al., 2009). Along the Golo valley, the architecture of the SL complex has been established based on the main metamorphic features observed in diagnostic rocks, such as metabasalts, metagabbros and continental basement rocks (*e.g.* Lahondère, 1996). Along this valley (cross section G), the observed *T* gaps are compatible with the main established metamorphic boundaries. Consequently, it is possible to interpret the RSCM-*T* gaps as first-order tectonic contacts separating tectono-metamorphic units. The geometry defined in the Golo Valley can then be extrapolated to metasedimentary-rich domains lacking diagnostic mineral assemblages, based on similarities in RSCM-*T*. On the contrary, the obtained RSCM-*T* match only in part with the lithostratigraphic boundaries among the four main metasedimentary formations (cf. Section 2.2.1). As an example, the *Upper Castagniccia* and *Santo Pietro di Tenda* formations are classically described as two different units. However, rocks referred to these formations plot as three distinct clusters of temperature, characterized by eclogitic and blueschist (Lawsonite-Blueschist and Low-grade blueschist) metamorphic conditions. Thus, in this case, lithostratigraphic features alone cannot be used to define tectono-metamorphic units that underwent independent Alpine evolutions. In other cases, those boundaries coincide with clear RSCM-*T* gaps which were not observed previously by means of classic metamorphic approaches. As an example, the *Upper Castagniccia* and *Lower Castagniccia* formations (cf. Section 2.1.1), which are separated by a significant and uniform *T* gap, cannot be considered as a single tectono-metamorphic unit as commonly proposed (*e.g.* Fournier et al., 1991 and Lahondère, 1996).

Combining our RSCM-*T* estimates with the available lithostratigraphic and metamorphic data provided from other lithologies (*e.g.* meta-ophiolites and continental basement rocks), the architecture of Alpine Corsica can be defined in terms of *tectono-metamorphic units*. This term is hereafter used to define domains characterized by a specific peak metamorphism and a specific lithological cortege (*i.e.* characteristic rock-types and metasedimentary formation). Nine main units can be distinguished in the SAC and CAD regions. Although the RSCM-*T* obtained in the NAC region are more scattered, results from the NAC region are incorporated in the general discussion of the units because the same succession of metamorphic units is observed as in the CAD and SAC regions. A more detailed characterization of the newly established units is provided in the supplementary material. Pressures values are from previous studies and are assumed to represent the peak *P* (cf. Section 2.2.2 for details).

From the lower to the upper structural position, these tectonometamorphic units are (Fig. 6 , Table 2 . See supplementary material for more details):

1. *The lawsonite* (*Law*) *Castagniccia unit*, characterized by an average RSCM-*T* of 475 °C in the SAC and a lower value of about 380 °C in the NAC. *P* is estimated at 1.4–1.7 GPa (Jolivet et al., 1998).

2. *The lawsonite-eclogite* (*Law-Ecl*) *OCT unit*. Homogeneous RSCM-*T* at about 520 °C are observed in the SAC, where the most recent *P* estimates of this unit are 2.2–2.4 GPa (Ravna et al., 2010 and Vitale Brovarone et al., 2011b). Otherwise, lower RSCM-*T* (average *T* = 464 °C, cf Table 2) are observed in the NAC. These rocks are associated with mafic eclogites, suggesting that both rocks experienced a slightly lower metamorphic *T* in the NAC with respect to the SAC. This feature suggests the occurrence of a *T* gradient decreasing from S to N within the Law-Ecl unit.

3. *The lawsonite-blueschist* (*Law-Bs*) *OCT unit*, yielding a RSCM-*T* of about 420 °C. Peak *P* is estimated at 0.8–1.0 GPa (Lahondère, 1996).

4. *The Lower External Continental units* unit (Corte-Francardo, Popolasca), showing RSCM-*T* of ~ 310 °C. Pressure is estimated at about 0.6 GPa (Marroni and Pandolfi, 2007).

5. *The low-grade blueschists* (*low-Bs*) *Tenda unit*, whose associated metasedimentary cover shows RSCM-*T* at around 360 °C (Table 2). Pressure values ranges between 0.8 and 1.4 GPa (Egger and Pinaud, 1998, Tribuzio and Giacomini, 2002, Molli and Tribuzio, 2004 and Molli et al., 2006).

6. The *low-grade blueschists* (*low-Bs*) *Bagliacone-Riventosa unit*. RSCM-*T* is estimated at about 350–360 °C, while no *P* estimate is available.

7. *The low-grade blueschists* (*low-Bs*) *Inzecca* (*s.l.*) *unit*, yielding a RSCM-*T* of 350 °C. *P* is estimated at about 0.8 ± 2 GPa (Levi et al., 2007).

8. *The Upper External Continental units* (Caporalino, Santa Lucia). This set of units shows slightly heterogeneous RSCM-*T* ranging from 272 to 313 °C (cf supplementary material for more details).

9. *The Nappes Supérieures.* This set of units yields an average RSCM-*T* of about 290 °C (*cf.* also supplementary material for more details). *P* is estimated at about 0.3–0.4 GPa (Marroni and Pandolfi, 2003).

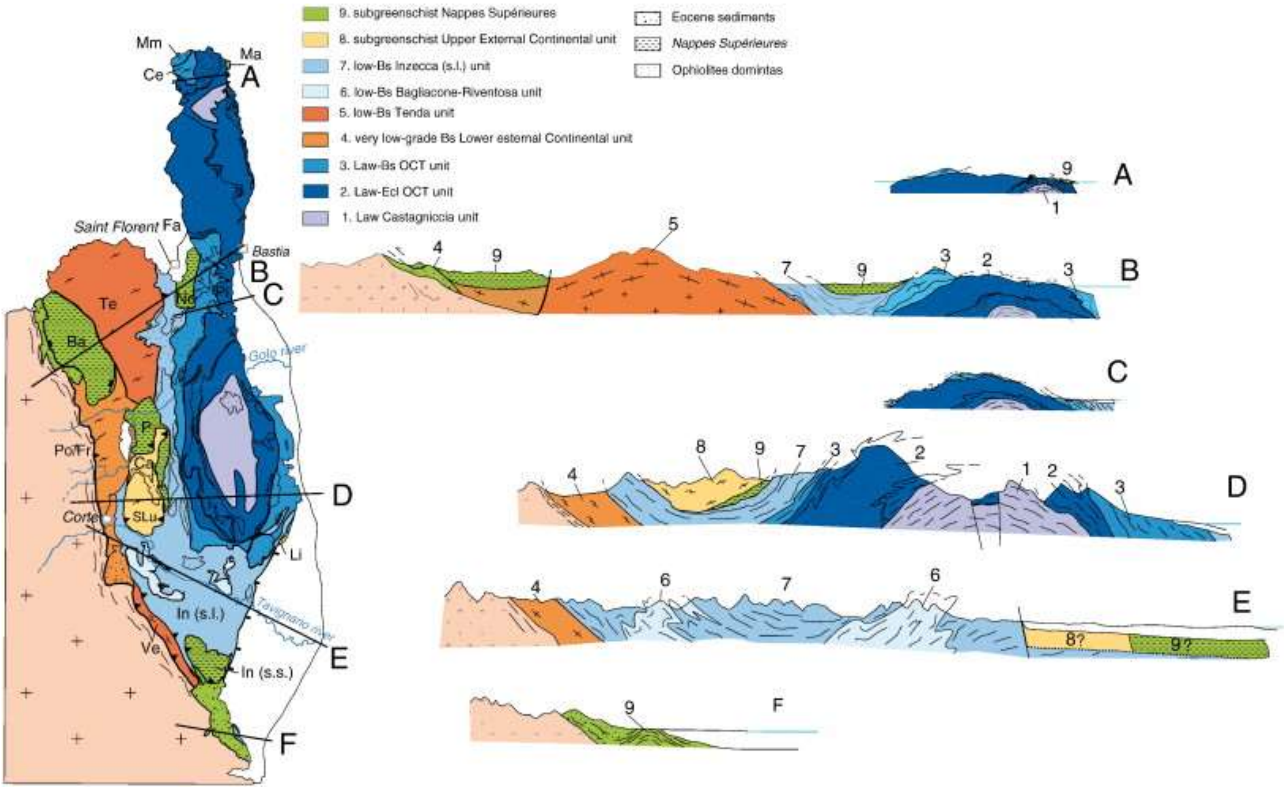


Fig. 6.

Distribution of the tectono-metamorphic units in Alpine Corsica as established in this study, and selected interpretative cross-sections of Alpine Corsica. See Figs. 3 a and 4 for tectono-stratigraphic details across the selected profiles.

6.3. Structural constraints on the Alpine Corsica evolution

Although the RSCM-*T* obtained in this study do not provide any chronological control in terms of kinematics, the geometrical relationships among the established tectono-metamorphic units allow for discussing some geological implications. Here, we only consider some key aspects mainly regarding the structure of the SL complex and its relationships with the other units of the Corsica belt.

The term "Schistes Lustrés" was introduced for the units of Alpine Corsica by the French authors, by analogy with the Tethys-derived metasediments and associated meta-ophiolites of the Western Alps (*e.g.* Amaudric Du Chaffaut et al., 1972 and Caron, 1977). Because of the lack of detailed metamorphic estimates all over the belt, the detailed internal architecture of the SL complex has been unraveled only locally (cf. Section 2.2). As a result, in many works, Tethys-derived metamorphic rocks have been considered as a single, often undifferentiated and tectonically consistent body, namely the SL complex. This view resulted in several simplifications, such as considering the structural and chronological relationships between the SL complex and the other units as homogeneous throughout the belt. However, our study together with past field studies shows the occurrence of different and coherent tectonometamorphic units within the SL complex, and suggests their independent evolutions during the Alpine orogeny. As an example, the eastern border of the Tenda unit (East Tenda Shear Zone –ETSZ– in Jolivet et al., 1991 and later authors) has been considered as a main tectonic contact responsible for the westward thrusting of the SL complex (including H*P*, eclogite-facies rocks) onto the Corsica continental margin during compressional regimes followed by crustal-scale stretching and thinning of the Alpine edifice during extensional tectonics (Jolivet et al., 1990, Jolivet et al., 1991, Fournier et al., 1991, Daniel et al., 1996, Jolivet et al., 1998, Jolivet et al., 2003 and Molli et al., 2006). In such model, a considerable displacement has occurred along this shear zone during both convergence and crustal-scale extension. However, our observations and results show that the SL rocks at contact with the Tenda unit (*i.e.* l*ow-Bs Inzecca* unit) experienced only a low-grade blueschist metamorphism comparable to that of the Tenda unit (T = 350 °C, P = 0.8–1.1 GPa, Tribuzio and Giacomini, 2002 and Molli et al., 2006; this study, Section 5.1). Metamorphic estimates thus indicate that material from both the hanging wall and the footwall of this shear zone experienced a similar metamorphic evolution, as also supported by structural data (Molli et al., 2006). Consequently, we consider that the ETSZ does not represent a major shear zone along which a crustal-scale displacement was accommodated during the post-peak evolution.

On the other hand, Tethys-derived rocks lacking clear metamorphic signature were included to the Nappes Supérieures, also occupying the uppermost structural position of the belt. This sharp distinction between metamorphic vs. poorly metamorphic rocks, together with the frequent difficulty in classifying metasediments lacking diagnostic minerals, triggered non-unambiguous interpretations. This is especially evident when considering that the SL complex includes rocks that underwent a relatively low-grade metamorphism (*e.g.* low-Bs units, 350 °C, 0.8 GPa. *cf.* 2 and 5.1), whose metamorphic overprint is only slightly higher than that of the Nappes Supérieures (300 °C, 0.4 GPa). Furthermore, in some areas (*e.g.* cross section J and K, Fig. 4), a gradual increase of RSCM-*T* is observed from material belonging to the Nappes Supérieures to the lower-grade units of the SL complex, suggesting the local absence of a sharp boundary between the two domains. Thus, this intrinsic complexity is at the base of some of discussions about the geology of Alpine Corsica, for instance regarding the age of H*P* metamorphism in this belt. As an example, aside from scarce and controversial pre-Eocene radiometric ages (cf. Section 3), the occurrence of Eocene unmetamorphosed sediments resting unconformably upon both the Hercynian Corsica and the Schistes Lustrés complex was used to constrain the H*P* metamorphism of the SL complex as pre-Eocene in age (Amaudric du Chaffaut, 1982, Egal, 1992 and Fellin et al., 2006). However, both units (SL and Eocene sediments) show comparable very low RSCM-*T* of about 300 °C (Fig. 3 and Fig. 4, Table 1). The lower unit (SL) was referred in the past to the H*P* units of the SL complex only on the basis of lithostratigraphic analogies with the *Inzecca* sedimentary formation (Egal, 1992), which, toward the north, shows blueschist metamorphism. Since samples from both units (SL and Eocene sediments) show comparable mineralogical/ features and the obtained RSCM-*T* are comparable, there is no evidence for a significant *P* gap between the two units. Consequently, we suggest that the two units underwent a comparable metamorphism postdating the deposition of Eocene sediments. These features indicate that the structures described by Egal (1992) do not represent a robust indication of obduction of pre-Eocene H*P* rocks of the SL complex onto the Corsica continental margin. This observation fits well with most of the radiometric ages available for the H*P* units of the SL, mostly indicating a Late Eocene age (*e.g.* Brunet et al., 2000 and Martin et al., 2011). However, the occurrence of a tectonic phase of westward thrusting pre-dating the deposition of Lutetian sediments cannot be excluded. On the basis of the results obtained in this area of southern Alpine Corsica we can also hypothesize the local occurrence of a continuous metamorphic gradient between the Nappes Supérieures terranes and the lower grade units of the SL complex (*i.e.* low-grade Blueschist units), which show comparable RSCM-*T*. Similarly, a possible gradual increase of metamorphism may also locally characterize the transition from the low-grade Blueschist unit and the Law-Blueschist unit (*e.g.* the Golo valley, cross section G, Fig. 4).

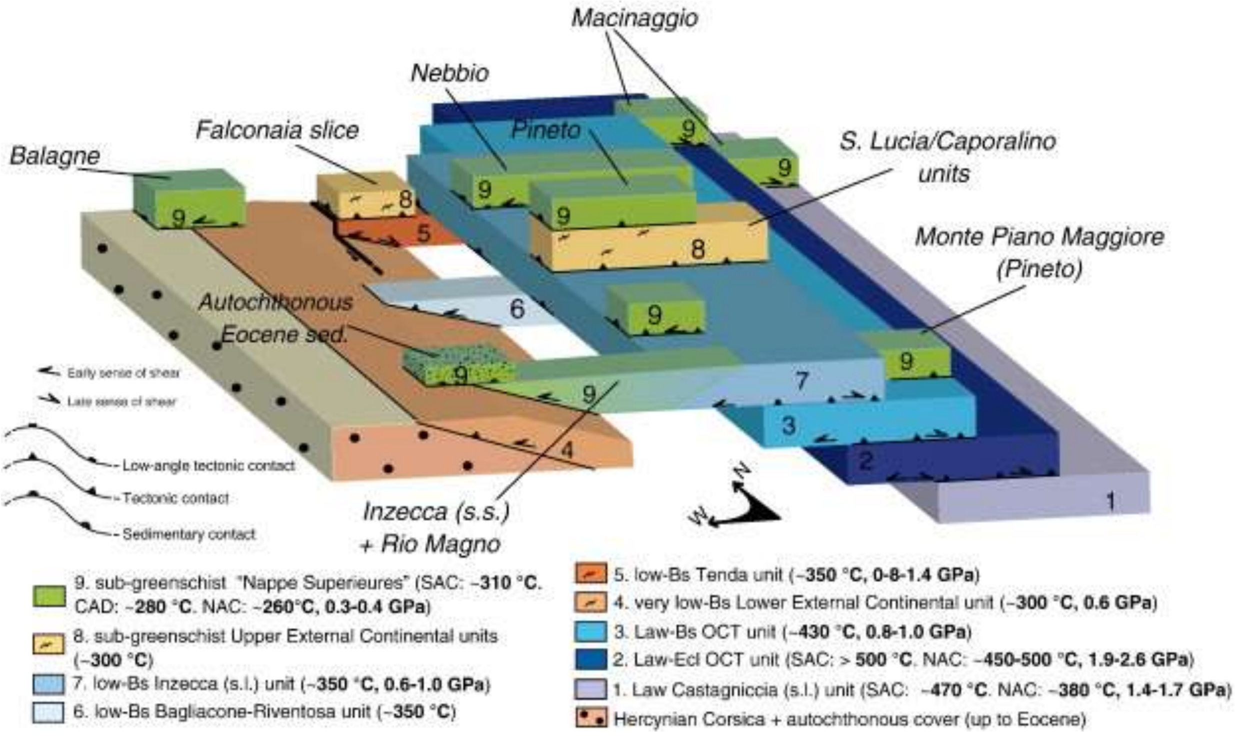
6.4. On the nature of Alpine-type orogenic processes: stacking and organization of inherited paleo-domains within Alpine Corsica

The large metamorphic dataset provided in this study, together with the extensive lithostratigraphic information available in the literature, reveal that Alpine Corsica results from the stacking of large tectonometamorphic units along a very limited number of major tectonic contacts. These contacts correspond to sharp and regionally continuous metamorphic gaps, marking the interfaces along which subducted materials were exhumed. This tectonic feature does not characterize only the low- or very low-grade metamorphic terranes, but also the deeply subducted H*P* units that in Alpine Corsica reached the lawsonite-eclogite stability field. It is noteworthy that the lower grade units (*i.e.* Nappes Supérieures and Upper External Continental units) generally show a more complex cartographic repetition of small tectonic slices characterized by a rather constant metamorphism (see below). Comparatively and somewhat paradoxically, primary and non-disturbed stratigraphy is observed over wide areas (*e.g.* Caron and Delcey, 1979, Vitale Brovarone et al., 2011a and Meresse et al., 2012) in higher-grade units. The same conclusions, *i.e.* the occurrence of large units showing coherent lithostratigraphy (*e.g.* Lombardo et al., 1978, Caron and Delcey, 1979, Lagabrielle and Cannat, 1990, Angiboust et al., 2009, Beltrando et al., 2010b and Vitale Brovarone et al., 2011a) and homogeneous H*P* metamorphism (*e.g.* recent quantitative reprisals by Angiboust et al., 2009, Gabalda et al., 2009 and Beltrando et al., 2010b), have been proposed for the high-pressure units of the Western Alps. This observation is hardly compatible with several mechanisms proposed for the exhumation of H*P* rocks in orogenic belts, such as the dismemberment of subducted material during subduction and its subsequent exhumation as “mélange” structures along the so-called subduction channel (*e.g.* Shreve and Cloos, 1986, Cloos and Shreve, 1988, Ballèvre and Merle, 1993, Guillot et al., 2000, Guillot et al., 2001, Gerya et al., 2002, Reddy et al., 2003, Forster et al., 2004, Federico et al., 2007, Bousquet, 2008, García-Casco et al., 2008, Guillot et al., 2009 and Blanco-Quintero et al., 2011; review by Agard et al., 2009). Although the presence of relatively minor tectonic contacts within the established major units cannot be excluded, these have likely played a minor role for the subduction and exhumation of large and homogeneous slices of lithosphere from depth.

The established units, which are characterized by a specific Alpine metamorphic overprint and occupy a specific structural position within the belt, have been referred in the past to different paleogeographic domains (cf. Section 3). This approach is of tremendous importance for the understanding of the subduction and orogenic dynamics, especially in a complex geodynamic setting such as the Western Mediterranean. In the geologic literature of Alpine Corsica, the paleogeographic attributions are in some cases arguable, as discussed in Section 3 and summarized in Fig. 8 a and b. Part of the differences among the reconstructions results from the ambiguities in the definition of independent tectonic units, also deriving from the scarceness of metamorphic estimates in large, metasedimentary-rich terranes. Based on the results provided by this study, an alternative paleogeographic reconstruction can be proposed (Fig. 8 c). Some of the new interpretations derive from the occurrence of juxtaposed units showing comparable metamorphic overprint, which may be considered as primarily contiguous domains. As an example, the Upper External Continental units and the Nappes Supérieures occupy a contiguous structural position (8 and 9 in Fig. 6 and Fig. 7), and are characterized by a comparable metamorphic RSCM-*T* of about 300 °C. This conclusion differs from the previous structural position proposed for these units, such as the Caporalino unit which was considered as a tectonic window below the SL complex (*e.g.* Rossi et al., 1994a). This interpretation led authors to consider the Caporalino unit as a part of the European continental margin (*e.g.* Rossi et al., 1994a and Peybernès et al., 2001). However, results of this study indicate that the ophiolite-bearing units overlying the Caporalino units belong to the Nappes Supérieures (cf. Section 6.1), indicating that these units lay structurally above the SL complex. Furthermore, locally, ophiolitic material of the Nappes Supérieures rests structurally below the continental material of the Upper External Continental units (Fig. 6 cross section I). This feature may indicate an early association/juxtaposition during subduction and/or the primary proximity of these units prior to subduction. Data provided in this study also support the hypotheses of a common origin for the Nebbio (Nappes Supérieures) and the Santa Lucia and Caporalino Units. According to some authors, these units can be considered as upper-plate material from a continental microblock (*e.g.* Boccaletti et al., 1980, Alvarez, 1991, Rossi et al., 1994b, Molli, 2008 and Molli and Malavieille, 2010) or from the Ardiatic margin (*e.g.* Argnani, 2009). Nevertheless, it is worth noticing that a position close to the Corsica continental margin for the Nappes Supérieures has been alternatively proposed several times in the literature (*e.g.* Durand-Delga et al., 1997, Rossi et al., 2002 and Durand-Delga et al., 2005). In a similar way, the Tenda, the low-Bs Bagliacone-Riventosa and the Inzecca (s.l.) units (structural position 5, 6 and 7, respectively) show comparable RSCM-*T* of 350-360 °C (Fig. 3 and Fig. 4) and contiguous structural positions (Fig. 7). From a comparison with data from other associated ophiolites and continental basement rocks of Alpine Corsica (*e.g.* Rossi et al., 2002, Vitale Brovarone et al., 2011a and Meresse et al., 2012), it is thus tempting to consider these units as not only associated from the time of H*P* metamorphism, as already suggested by Molli et al. (2006) along the eastern margin of the Tenda Unit, but also as originally contiguous in the Tethyan realm. No particular paleogeographic inconsistencies result from considering the Bagliacone-Riventosa unit as an autochthonous cover of a lateral equivalent of the Tenda unit toward the south. Similarly, metasediments belonging to the Inzecca (s.l.) unit are closely associated with the silicoclastic, continent-derived metasedimentary rocks that crop out in the area of Santo Pietro di Tenda along the eastern border of the Tenda unit. This feature suggests a primary contiguity between the continental margin of the Tenda unit and the “oceanic” rocks of the *Inzecca* (*s.l.*) *unit*. The resulting distribution of paleodomains (Fig. 8 c) thus derives from the overlap of lithological assignments and a widespread metamorphic dataset covering all units of Alpine Corsica. This reconstruction, which takes into account the most favored paleogeographic origins (cf. Section 3) with some modifications after this study, may be related to the present-day structure of the belt by means of a progressive underthrusting of contiguous lithospheric sections of a subducting thinned continental margin and associated OCT. In fact, the combination of paleogeography and metamorphism in the terranes of Alpine Corsica shows a progressive transition of metamorphism from a very low-grade metamorphism in continental margin units to a H*P*, lawsonite-eclogite facies metamorphism in OCT units. The attribution of Alpine Corsica to an east-dipping (*i.e.* Alpine) or to a west-dipping (*i.e.* Apenine) subduction is still debated (cf. Section 3). The discussion of this open question is beyond the aim of this paper, and our results are integrated in an east-dipping subduction system (Fig. 8 d, e), which is the most acknowledged model in recent publications (cf. *review in* Molli, 2008 and references therein; Argnani, 2009, Molli and Malavieille, 2010 and Ravna et al., 2010). Importantly, the choice of a west-dipping subduction would strongly modify the paleogeographic interpretation of some units. This model of progressive underthrusting would imply i) a rejuvenation of peak metamorphic ages from the upper to the lower structural positions, and ii) an increase of metamorphic conditions from the highest- to the lowest-grade units. This latter hypothesis is always confirmed, with the exception of the Law-Castagniccia unit, which occupies the lowermost structural position and shows a lower metamorphic grade with respect to the overlying La-Ecl unit. However, geological constraints on the origin of the Castagniccia unit are still highly incomplete. Furthermore, this model can only explain part of the complex evolution of Alpine Corsica, which also depends on the structural overprint caused by the subsequent Apennine subduction and opening of the surrounding basins (*i.e.* Liguro-Provençal and Tyrrhenian). Thus, following this model of progressive underplating, older H*P* ages are expected in the overlying lower-grade units (*i.e.* Law-Blueschist and low-grade blueschist units), as recently proposed by means of Lu–Hf geochronology on lawsonite (Herwartz et al., 2012 and Vitale Brovarone and Herwartz, submitted for publication). This feature suggests the need of new and exhaustive geochronological data, aiming at confirming the existing controversial constraints and accounting for the geometrical, metamorphic and paleogeographic constraints proposed in this study.

Fig. 7.

Schematic reconstruction of the architecture of Alpine Corsica. The vertical and horizontal geometric relationships refer to the observed juxtaposition and geographic distributions among the different units, respectively. Thickness of units is arbitrary.



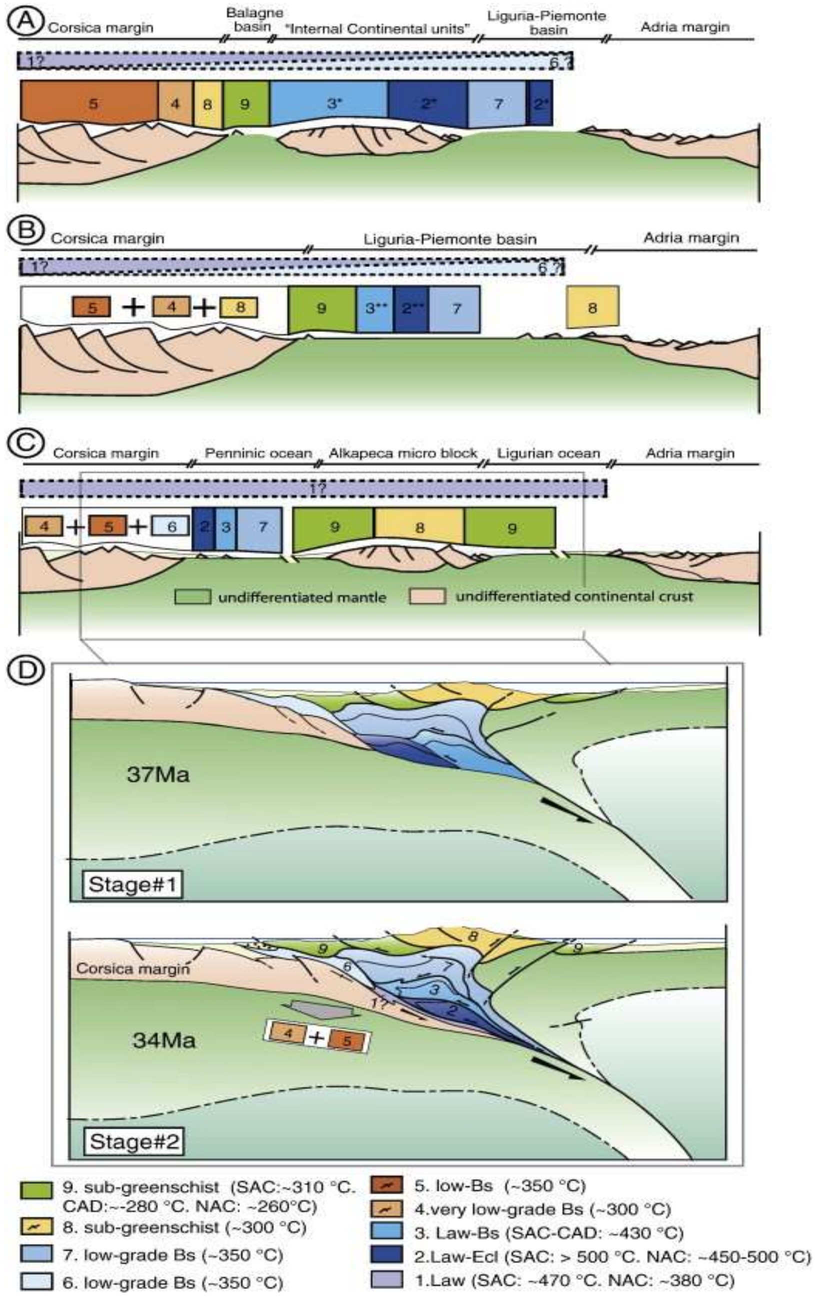


Fig. 8. a, b, c: Different paleogeographic reconstructions at Late Cretaceous showing the location of the newly established tectono-metamorphic units. See text for details on the different interpretations. (a) The Internal Continental Units are interpreted as remnants of a single microblock separating the future Balagne unit from the main Liguria-Pemonte basin. Compiled after Lahondère (1996) , Lahondère et al. (1999) , Padoa et al. (2001) , Peybernès et al. (2001) , Rossi et al. (2001) . (b) The H*P* units of the SL complex are considered as internal in the Liguria-Piemonte basin, and the Balagne unit is considered as the OCT of the Corsica margin. Compiled after Dallan and Nardi (1984) , Marroni and Pandolfi (2007) , Argnani (2009) . (c) The H*P* units of the SL are considered as the OCT of the Corsica margin, and the Upper External Continental units and the Nappes Supérieures (e.g. Balagne unit) are interpreted as remnants of a microblock separating the Penninic and Ligurian oceans. Compiled after Molli (2008) , Molli and Malavieille (2010) ; Vitale Brovarone et al. (2011a) and this study. Note that some paleogeographic attributions depend on the choice of an east-dipping subduction (cf. discussion in section 6.4). (d) Possible schematic tectonic model for Alpine Corsica considering a progressive underplating of contiguous lithospheric sections. Based on the paleogeographic configuration proposed in c. An east-dipping subduction is chosen according to most recent bibliography (e.g. Molli, 2008, Argnani, 2009, Handy et al., 2010, Molli and Malavieille, 2010 and Ravna et al., 2010). Timing of metamorphism from Vitale Brovarone et al. (2012) . In d, the Castagniccia unit is interpreted as the cover of the Corsica continental margin. * Distribution of continental basement rocks and ophiolites forming units 2 and 3 prior to their interpretation as an early OCT lithological associations. ** Undifferentiated ophiolitic and continental basement material in units 2 and 3.

7. Conclusions

A detailed review of the structural, metamorphic and lithostratigraphic features of Alpine Corsica (especially the highly metamorphosed Schistes Lustrés complex), together with a new and exhaustive metamorphic dataset is presented in this paper. This allows for updating and clarifying the knowledge on the architecture of the belt. Nine main and large units, characterized by an internally homogeneous Alpine metamorphic overprint and a specific structural position, were recognized. On the basis of their internal structure and lithostratigraphy, these units represent large segments of subducted lithosphere that behaved coherently during subduction and orogeny. In the large Schistes Lustrés complex, four main tectono-metamorphic units are defined. Although the occurrence of sub-units is known since many decades, the coupling between lithostratigraphic and metamorphic features was often vague. In this study we provide a detailed characterization and distribution of these terranes by means of the available lithostratigraphic data and a new metamorphic dataset. These data allow for (i) discussing the paleogeographic origin of these terranes and (ii) creating a stronger link between paleogeography (*i.e.* the relative position among different domains before orogeny) and the whole orogenic cycle. This reconstruction represents an original insight to unravel subduction and orogenic processes in this belt. This study also clarifies the meaning of regional chronological constraints (*e.g.* relationships between metamorphism and emplacement of large volumes of rocks) and provides fundamental insights for the future study of Alpine Corsica in the frame of the evolution of the Western Mediterranean and Alps/Apennine systems. Alpine Corsica shows a progressive metamorphism from very low-grade in continental margin units to H*P* lawsonite-eclogite facies conditions in OCT units. Thus, this belt represents an exceptional example of fossilized subduction complex involving a subducted continental margin. In many other Tethyan-type belts (*e.g.* the Western Alps) the early stage of continental subduction is often obliterated during the collision tectonics. Therefore, the tectonic stacking of Alpine Corsica can be considered as a snapshot of the critical lapse of time separating intraoceanic subduction and collision.

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