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The historical collection of minerals and rocks from Egypt preserved at the Regional Museum of Natural Sciences (Torino, Italy)

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Abstract

A collection of minerals and rocks from Egypt, made up of about 700 specimens preserved at the Museum of Natural Science in Turin, was studied. Thanks to some ancient manuscripts and fragments reporting name of localities, the mining engineer Carlo Boreani can be considered with reasonable certainty the author of the collection, in collaboration with his secretary, the lawyer Giovanni Pollonera. Both worked in Egypt at the service of the viceroy Muhammad Ali in the first half of the nineteenth century.

The collection, consists of the most common rocks used by Ancient Egyptian and was often used for exhibitions in Italy and abroad. The collection was integrated by a digital catalog, which makes it accessible to a large audience. The rediscovery of this collection allowed to enhance knowlwdgeand deepen the study of materials that represent a historical, scientific and cultural asset to be promoted.rediscovered, also with the contribution of the multimedia resources now available

Key words: historical collections, Egyptian rocks, Carlo Boreani, Regional Museum of Natural Sciences Museo Regionale di Scienze Naturali

INTRODUCTION

Since its foundation, in 1978, the Regional Museum of Natural Sciences of Turin (MRSN) has been entrusted with the preservation, recovery and reorganization of over 50,000 specimens of the historical collections of mineralogy, petrography, geology, and palaeontology of the University of Turin. Since its foundation in 1978, the University historical collections of mineralogy, petrography, geology and paleontology were stored in the Regional Museum of Natural Sciences in Turin (MRSN). The proceeding of recovery and reorganization of the historical collections undertaken since 1983, and still active, concern over 15,000 mineralogical and lithological samples cataloged and Of these, at least 7000-8000 specimens of minerals and rocks are still to be cataloged, which for various reasons have merged with the Turin Mineralogical Museum over the course of over 250 years (Gallo, 2004) . In particular, in 2008 a restoration and reorganization of the so-called "Collection of minerals and rocks of Egypt", a relatively homogeneous set of about 700 specimens collected in the first half of the 19th century, was undertaken (Barale, 2009;~~,~~ Barale et al., 2014).

The interest on this collection was dictated by a twofold needs. First of all, in that period the first studies on the stone materials of the Egyptian Museum of Turin (Borghi et al., 2015) were starting, with the consequent need to have some stone material for comparison with archaeologic finds, not being able to use fragments derived directly from the sta~~t~~ues~~-~~ .

At the same time, the Regional Museum of Natural Sciences of Turin, in collaboration with the Egyptian Museum, undertook the planning and preparation of a series of temporary exhibition events in which the selection~~exibition~~ of mineralogical and petrographic samples within the museological itinerary was needed. Consequently, the recovery of the collection provided~~offered~~ the possibility of making specifically requested material available to the curators of the exhibitions~~posures~~. For example~~In fact~~, ~~some~~ selected samples collection were used in the exhibition “Nefer: The woman in ancient Egypt” in Turin (2006) and Milan (2007) and in the various editions of the exhibition “From Nature to Art. History of stones, animals and plants in the Nile Valley" in Turin, Naples, Potenza and Nice (D'Amicone & Giacobino, 2005).

More recently, i~~I~~n view of the forthcoming re-opening of the MRSN to the public, the design of the layout of a new exhibition hall called *Arca* is underway. It will be dedicated to the main travels and explorations that have enriched the Museum collections over the years. Of the twenty-two ship ribs in which the space will be divided, one rib will be dedicated to the minerals and rocks collection of Egypt.~~,~~

HISTORICAL AND GEOGRAPHIC SETTING

From the original manuscript fragments (inside bags containing sand samples) a reference date was identified (January 14, 1838, see Fig. 1A) and the name of Carlo Boreani (1798 - 1850) was found from archival research. A mining engineer originally from Acqui Terme (AL), artillery officer at the Turin Arsenal, Boreani was involved in the insurrections of 1821 in Alexandria (~~in~~ Piedmont, Italy), from which he fled to repair first to Lisbon and then to Cairo, where he worked~~operated~~ in the first half of the Nineteenth century at the service of the viceroy Mohammed Alì, in collaboration with his secretary, the lawyer Giovanni Pollonera (1808 - 1850). In 1822, Borreani dedicated to prospecting for gold in the Khartoum area (Sudan). In 1825, he~~Borreani~~ became director and chief of engineers of the arsenal of Bulaq, a small city near Cairo, where worked~~operated~~ for a certain period to the production of weapons of various types. In 1833-1836 he carried out mineral prospecting in the Tauros mountains (southern Turkey) on behalf of Ibrahim Pasha, commander of the Egyptian army in Syria, and identified two deposits of iron and one of lead in Kouroamgé (Syria) together with~~other then~~ various copper minerals and galena (lead silver) (Hill, 1967).

In 1837-1838, Boreani, together with Pollonera, took part in ~~was sent on~~ an expedition in~~to~~ Sudan, where it was believed~~suspected~~ that there were very rich deposits of gold in Kordofan area and in the district of Fazoglou: between 1838 and 1839 the two explorers participated in a second expedition commissioned by Mohammed Ali to the district of Fazoglou, where the gold-bearing sands and rocks of the surrounding mountains (granites, quartzites, sandstones, etc.), well represented in the collection, were collected.

From the set of geographical, geological, historical and bibliographic data, the direct correspondence between the samples of the various locations of the collection and the activity of Carlo Boreani in Egypt and Sudan was amply demonstrated (Barale et al., 2014). So, likely, the sampling was done entirely by Boreani or, in part, under his direction. Pollonera may have participated or, as Boreani secretary, supervised the organization of the collection.

The way in which the collection reached the Mineralogical Museum of Turin appears to be much complicated. Boreani died in Constantinople on 13 December 1850, according to some sources without returning to Piedmont. ~~i~~In 1850 also Giovanni Pollonera died in Egypt and the widow married, in second marriage, with Michele Lessona. He went to Egypt as a doctor and returned to Turin in 1850~~.~~. In Italy Michele Lessona (1823 -1894) in 1865 became professor of zoology, as well as director of the Zoological Museum of Turin.

It is likely that Giovanni Pollonera leaves the collection of rocks to Michele Lessona~~-~~, who gave the material to his colleague Angelo Sismonda, director of the Mineralogical Museum, considering that the Zoology Museum and the Mineralogical Museum of the University of Turin in the mid-19th century were located one next to each other on the first floor of Palazzo Carignano.

THE COLLECTION

The collection of Minerals and Rocks of Egypt is a collection belonging to the historical collections of the Museum of Mineralogy and Petrography of the University of Turin and is currently kept on loan for use at the MRSN.

the collection is mainly made up of igneous rocks, followed by metamorphic rocks, minerals and sedimentary rocks. F~~rom a first observation it can be noted that, within the collection, the group of magmatic rocks is the most numerous. This is followed by the group of metamorphic rocks, that of minerals and finally that of sedimentary rocks.~~ Today the rock samples are arranged in special cardboard containers of various dimensions (6 cm x 4.5 cm, 9 cm x 6 cm, 12 cm x 9 cm and 18 cm x 12 cm), inside Allibert-type boxes (-60cm x 40cm x 12cm) (Fig. 1). The collection consists of 699 samples including: 242 magmatic rocks , 116 sedimentary rocks (8 of which are loose sands), 174 metamorphic rocks and 167 minerals-.

Each sample in the collection is accompanied by a handwritten tag, i.e. a sheet of paper on which the progressive number of the sample, the petrographic denomination of the rock or mineral, the country of provenance, which resulted the Egypt for 220 samples, is reported. In a few cases, the place of origin is also indicated. These tags are not the original ones compiled by the organizer of the collection, but were drawn up at the end of the 19th century in an undefined phase of reorganization of the collection. The few locations shown on the collection tags correspond to locations that are found today, for the most part, in Egypt and Sudan. The localities in question are: Mount Taurus (2 samples), Mount Bérénis (3), Red Mountain (63), Blue Nile (1), Soukan (10), Crusco (1), Fazouglou (13), Zehad (1) , Kordophan (1), Mount Sinai (7), Pi Ghizel (1) and Syria (1) (Fig. 1B).

In particular, the Red Mountain (in Arabic Gebel Ahmar), is located near Cairo, at the ancient city of Heliopolis. This locality represents one of the most exploited stone material extraction sites in Ancient Egypt. The meta-sandstones used in the production of statues, sarcophagi and architectural elements under the reign of the Pharaohs Akhenaton, Amenhotep, Tutankhamun and Ramesses III come from the Red Mountain.

Soukan may be a wrong transcription of the city of Aswan, from the Coptic name Souan. This city is located in southern Egypt, on the East bank of the Nile, at the height of the first cataract. In ancient times it was a very important locality as it was located at a strategic position: which allowed for control ~~in fact it controlled~~ the river traffic of the ships that departed from Nubia or traveled to this region. Furthermore, it was one of the most important granite extraction sites in Ancient Egypt. Here were located, and are still visible today, the famous pink granite quarries exploited and used by the Egyptians, but also in later times by the Romans.

Fazouglou (or Fazoglo) is the name of a Sudanese place located in the homonymous district on the border between Sudan and Ethiopia, along the Blue Nile.

Kordophan (or Kordofan) is the name of a region in central Sudan; it is mainly characterized by plains and to the southeast are the Nubain Mountains.

THE PETROGRAPIHC DESCRIPTION

Thanks to the large variety of stone materials, it has been possible to identify some lithological varieties that were widely used in the production of artistic and architectural assets from the Egyptian and Roman times, such as, for example, monumental pink granite, black granite, Nubian sandstones and meta-sandstones of Gebel Ahmar, some types of gneiss and the Bekhen Stone (a dark green greywacke). Some lithological varieties have also been identified, which, due to their mechanical, physical and aesthetic characteristics, have never been used for artistic and decorative purposes, such as some types of metamorphic rocks.

To facilitate the classification of the lithotypes of the collection that were used in Egyptian artistic production, in this study the samples were divided into various homogeneous lithological groups on the basis of their macroscopic characteristics. For the most significant varieties, further characterization was carried out on the basis of microscopic observations and mineral-chemical analyses, with the production of 22 thin sections. Where possible, the observed varieties were compared with the electronic images of Egyptian rocks developed by James Harrell at the site: www.eeescience.utoledo.edu/Faculty/Harrell/Egypt/AGRG_Home.html.

Among the magmatic rocks, two main categories have been identified: pink and red granites and black granites.

THE PINK AND RED GRANITES

The term "pink granite" identifies a phaneritic rock with a heterogeneous grain-size and a porphyritic texture, with a variable color between light pink and intense red. In general, pink granite is characterized by a color index ranging from 10 to 15% and by a high percentage of potassium feldspar, which gives the hand-made samples a pink colour. They were quarried in the area of Aswan, in the middle Egypt, along the Nilo River and transported throughout the lands of the kingdom up to delta Nile. Within the collection of Minerals and Rocks of Egypt, four types of pink granite have been identified: monumental pink granite (sections IB1, IB5 and IB29) (Fig. 2a), fine-grained pink sienogranite (IB7) (Fig. 2b), biotite~~ic~~ bearing vpink granite (IB28) (Fig. 2c) and pink alkali-feldspar granite (IB9 and IB11) (Fig. 2d).

Macroscopically, the grain-size of these samples varies from fine-grained for the specimens of alkalifeldspar pink granite and ~~fine-grained~~ sienogranite, to medium-coarse and heterogeneous for the other categories of pink granite . The samples of monumental pink granite and biotite~~ic~~ bearing pink granite have a phaneritic texture with a porphyritic texture. These rocks are distinguished by the occurrence of centimeter-sized crystals of potassium feldspar surrounded by the medium-grained matrix of the rock.

The most abundant sialic mineral is certainly the potassium feldspar, which varies from 20% to 50%. To t~~T~~his mineral is primarily ascribable~~responsible for~~ the ~~noticeable~~ pink color on hand specimens. The other sialic minerals typical of pink granites are quartz (in quantities varying between 30% and 50%) and plagioclase (in quantities varying between 5% and 25%). Accessory minerals such as allanite, apatite, sphene, and Fe and Ti oxides often occur~~are abundant~~. The most abundant mafic mineral is the biotite. The presence of green amphibole was also found in the monumental pink granite specimens. In alkali-feldpathic pink granite, on the other hand, biotite is not present, but only green amphibole.

The pink and red granites were abundantly used by the Egyptian civilization in statuary and for important architectural elements such as obelisks, columns and pilasters. Numerous finds in "red granite" are conserved in the Museo Egizio~~Egyptian Museum~~, such as the statue ~~of Statue~~ of Amenhotep II Cat. 1375 (Fig. 3), carved in a pink granite very similar to sample no. 111 of the collection.

THE BLACK GRANITES

The definition of “black granite” includes some categories of intrusive igneous rocks comprising granodiorites, quartz-~~o~~diorites, diorites, tonalites and gabbros . ~~Also this type of~~These rocks were quarried near Aswan, along the course of the River Nile. The samples analyzed in this petrographic study that fall into this classification are two samples of granodiorite (IB6 and IB4) (Fig. 4a), one sample of quartz-~~o~~diorite (IB8) (Fig. 4b), two samples of tonalite (IB3 and IB12) (Fig. 4c) and one sample of gabbro (IB15) (Fig. 4d).

This group of lithotypes has in common a very high color index (about 40-50%) which gives the specimens a gray-black color and a dark macroscopic appearance.

These rocks are characterized by a grain-size that varies from medium-fine ~~-~~to medium~~-~~. In particular, granodiorites show a porphyritic texture with phenocrysts of potassium feldspar ranging in color from white to intense pink and quartz.

In general, among the femic minerals, green amphibole and biotite occur in black granites. In granodiorite, quartz-~~o~~diorite and tonalite samples, amphibole is present in higher quantities than biotite. On the other hand, in gabbro, femic minerals consist of clinopyroxene and olivine.

The most abundant sialic mineral in black granites is plagioclase, the percentage of which is estimated at around 20% for granodiorites, tonalites and quartz-~~o~~diorite, and up to 45% for gabbro. Its crystals, from anhedral to euhedral, show a strong alteration due to the saussuritization of the calcium-rich portions~~—~~, especially in the quartz-~~o~~diorite sample.

Another sialic mineral of black granite is quartz. Its percentage varies from 10% (quartz-~~o~~diorite) to 25% (granodiorite).

Finally, small amounts of potassium feldspar (5-10%) have been identified in the granodiorite samples.

This type of rock was widely used by the ancient Egyptians in statuary and, in particular, in the carve of the 365 statues of Sekhmet, the Goddess of Medicine and fertility, originally placed in the "Temple of Millions of Years" of Amenhotep III at Karnak. Some of these statues are kept in the Egyptian Museum (Fig. 5). From a comparison with sample no. 107 of the collection shows that the statue in question was carved in Aswan granodiorite.

THE SEDIMENTARY ROCKS

Among the Egyptian sedimentary rocks, the Nubian sandstones, the meta-sandstones of Gebel Ahmar and the Bekhen Stone play a particular role in the field of cultural heritage .

Both lithological varieties are represented within the collection of minerals and rocks of Egypt by a large number of samples. In fact, most of the sedimentary rocks present in the collection ~~-~~ belong to these two lithological varieties.

Nubian sandstones are mainly made up of rounded quartz clasts and have a homogeneous texture and very fine grain-size. These rocks are poorly cemented and and show low toughness ~~very friable~~ (Fig. 6a).

The collection of Minerals and Rocks of Egypt consists of a group of Nubian sandstones in which two different varieties~~types~~ can be observed: ~~there are~~ sandstone ~~samples~~ with light bands, and light yellow variety. The petrographic study was carried out on both types (IB19 and IB20). The rock is mainly made up of quartz clasts (about 70% ~~.~~ based on image analysis).~~This mineral occupies about 70% of the thin section.~~ The individual clasts have anhedral habit and a sub-spherical shape, quite rounded (Fig. 6b). Sometimes, between the quartz clasts, aggregates of white mica occurred. There are also some clasts of sub-rounded potassium feldspar with a turbid appearance. Among the accessories, some idiomorphic tourmaline clasts can be observed. Around the quartz clasts a thin film of the fine-grained clay matrix occurs,~~.~~ that~~-~~appear yellow-orange ~~With~~at parallel polarizers ~~it appears yellow-orange in color and is clayey in nature~~. It occupies about 8% of the thin section. The rock shows a high porosity which can be estimated at around 20-25%.

The meta-sandstones of Gebel Ahmar, on the other hand, are mainly made up of recrystallised quartz clasts with sharp edges and show a fine and homogeneous grain-size (Fig. 6c). These rocks, originally of a sedimentary nature, were subjected to contact metamorphism by the circulation of hydrothermal fluids which led to the formation of meta-sandstones.

In the collection of Minerals and Rocks of Egypt the meta-sandstones have very different macroscopic characteristics. The color of these rocks varies from the typical dark~~-~~-red to light~~-~~-yellow, brown, purplish and pink. The macroscopic aspect is also variable: some samples appear layered~~are listed~~, while others are more homogeneous. These characteristics depend on the different distribution of the cement rich in iron oxides and hydroxides (fig. 6d).

The Bekhen Stone, on the other hand, is a fine-grained greywacke with homogeneous texture of a dark gray colour, made up of quartz, chlorite, epidote and white mica (Fig. 7a). This rock was quarried in the Wadi

Hammamat region, in the Eastern Desert, and was chosen by the Egyptians for the creation of artifacts of considerable aesthetic value, as the three sargofagous exposed at the Museo Egizio of TurinEgypt Museum (Fig. 8).

In the collection this lithological variety is represented by a single sample on which the petrographic study was carried out (section IB2). Microscopically, it shows a granular texture typical of clastic sedimentary rocks and is composed of tightly packed quartz and feldspar grains and lesser amounts of lithic fragments, chlorite, muscovite and epidote grains (Fig.7b). Texturally, it is a fine to very fine sandstone (grains finer than 250 microns) and quite well sorted.

METAMORPHIC ROCKS

The most abundant variety in the collection is represented by anorthositic gGniess, a fine-grained metamorphic rock made up of light-coloured layers rich in quartz and plagioclase and dark--green layers rich in amphibole (Fig. 7c). This gneiss was used to make vases and daily life objects. Macroscopically it has a light color and was found in the Western Desert of Egypt, . in the Toshka Oasis region, about 65 km NW of Abul Simbel.

Other metamorphic rocks in the collection are i) granofels, a: fine-grained and homogeneous metamorphic rock with massive granoblastic texture; ii) greenschists, a: medium-fine grained metamorphic rock consisting of albite, amphibole, chlorite and epidote and characterized by sub-parallel surfaces that define schistosity (Fig. 7d); iii) calcschists, a: medium-grained metamorphic rock -with alternating levels of silicate and carbonate minerals that define the main schistosity.

The tab. 1 schematically reportssummarize the compositions of the rocks analyzed with the constituent minerals and accessory minerals.

THE CATALOG

Finally, the finds are being cataloged following the national cataloging standards (http://www.iccd.beniculturali.it/it/standard-catalografici) through the use of the "Memora" application, the web platform used to catalog and enhance the cultural heritage present in the Piemonte Regiondmont. Memora is the tool used by the Piemontedmont Region for the cataloging of Cultural Heritage, the collection of digital objects and free use on the Web (https://www.memora.piemonte.it/#/) Memora is an open source software consisting of two components:, "Memora Back End", which allows operators of archives, museums and cultural institutes to catalog and describe the heritage and "Memora Front End" for the publication, consultation and use of the data. It describes the assets object of the cataloging in an integrated way and allows establishing relationships between the resources, using national descriptive standards . It allows to structure data re-ordering and digitization projects, and the textual contents can be accompanied by images, digital documents, audio and video.

The following fields were assigned for each sample: sample type, collection name, collection number, original denomination, current denomination, macroscopic description, thin section number, microscopic description, original locality, S~~s~~tate, curatorial notes, dimensions, location, card editor and date of creation. ~~-~~Memora is a tool that offers high interoperability allowing to export data in the most popular formats (xml, excel, pdf, etc.). Finally, it offers the possibility to geolocalize~~te~~ and view resources on maps. The Regional Museum of Natural Sciences has joined Memora for the cataloging of its naturalistic assets.

CONCLUSIONS

The historical collection of Minerals and Rocks of Egypt preserved at the Regional Museum of Natural Sciences of Turin constitutes a fundamental nucleus of Egyptian stone and mineral materials that can be used for scientific and archaeological purposes. It represents a large part of the lithological varieties occurring throughout the Egyptian territory. The collection consists of igneous rocks from the Aswan region and the Eastern Desert, sedimentary rocks from northern Egypt and Nubia, and metamorphic rocks from the Western~~Eastern~~ Desert.

From the study of the sources and data made available by the collection, it was possible to identify the authors of the collection and define the period in which the collection was set up~~ed~~.

The petrographic analysis and the comparison with the mineral-chemical data of quarry samples have made it possible to define with a good approximation the place of origin of many of the samples in the collection. A good petrographic correlation was also highlighted between the stone materials in the collection and the materials used by the Ancient Egyptians in the statuary of the Museo Egizio ~~Egyptian Museum~~ of Turin. Finally, an electronic catalog of the collection is being prepared, where for each sample the main geological, petrographic and museal data ~~of a a~~ are reported.

In conclusion, the study of this collection made it possible to enhance and deeply known , stone materials that represent a historical, scientific and cultural asset to be rediscovered. Historical research, original documents, knowledge of the conservation status of the collections and the characterization of the materials through scientific analyses allowed to determine and classify all the material collected to consider this collections as a flagship of the cultural heritage of the city of Turin and his~~the~~ University.

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CAPTIONS

Fig. 1 - A: The paper package which contained a sand specimen and which bears the only date found (January 14, 1838~~;), (~~from Barale et al., 2014); B: Sites of origin of the samples of the collection. 1. Taurus Mountains; 2. Mount Bérénis; 3. Red Mountain; 4. Nil Bleu; 5. Aswan; 6. Fazouglou; 7. Kordophan; 8. Mount Sinai; 9. Syria. From http://www.ancient-egypt-online.com/images/ancient-egypt-map.jpg, modified.

Fig. 2 - Representative sample of red and pink granite. A: monumental pink granite, B: fine-grained pink sienogranite, C: biotite bearing~~ic~~ pink granite, D: pink alkali-feldspar granite.

Fig. 3 - Monumental pink granite form. Macroscopic (A) and microscopic (B) image of Sample No. 111 from the collection of Minerals and Rocks from Egypt; C) Statue of Amenhotep II exposed at the Museo Egizio ~~Egyptian Museum~~ of Turin (cat. 1375).

Fig. 4 - Representative samples of black granite. A: porphyritic granodiorite , B: quartz-diorite, C: Tonalite, D: gabbro

Fig. 5 - Granodiorite form. Macroscopic (A) and microscopic (B) image of Sample No. 107 from the collection of Minerals and Rocks from Egypt;~~ C)~~ Goddess of Medicine Sekhmet (standing, 247 and sitting, 251) exposed at the Museo Egizio~~Egyptian Museum~~ of Turin (cat. 247, 251).

Fig. 6 - Representative samples of sedimentary rocks. A: Nubian sandstone, B: detail of the texture of the sandstone, in which quartz clasts, a fine matrix and abundant porosity are observed. In the center of the image is a staurolite clast.~~.~~ SEM (Scanning Electron Image) image in backscattered electron mode; C: Gebel Amar meta-sandstone~~, ~~; D: detail showing the quartz clasts surrounded by a secondary cement rich in iron hydroxides.~~,~~ SEM image in backscattered electron mode

.**Fig. 7 -** A: macroscopic image of the Bekhen Stone; B: microscopic appearance of the rock, characterized by sub-rounded clasts of quartz and albite immersed in a phyllosilicate matrix of white mica, chlorite and epidote. SEM image in backscattered electron mode. AB: albite; CHL: chlorite; EP: epidote; QTZ: quartz; WM: white mica. C: macroscopic image of anorthositic gniess; D: greenschists

Fig. 8 - Bekhen Stone form. Macroscopic (A) and microscopic (B) image of Sample No. 679 from the collection of Minerals and Rocks from Egypt; C) Sarcophagi of Gemenefherbakh, and D) Ibi Shepmin (cat. 2202 and 2203) exposed at the Museo Egitto~~Egyptian Museum~~ of Turin (cat. 2202, 2203).

Table 1: List of samples selected for petrographic analyses

Petrographic classification	Thin section specimen number	Mmain minerals	Aaccessory minerals
Monumental pink granite	IB1	Quartz 35%, pPlagioclase 25%, potassium feldspar 30%, biotite 5%, green amphibole <5%	Apatite, zircon, sphene, allanitic epidote, opaque minerals
Monumental pink granite	IB5	Quartz 35%, pPlagioclase 30%, potassium feldspar 25%, biotite 5%, green amphibole <5%	Apatite, zircon, sphene, allanitic epidote, opaque minerals
Monumental pink granite	IB29	Quartz 35%, pPlagioclase 20%, pPotassium feldspar 30%, green amphibole 10%, biotite 5%	Apatite, sphene, opaque minerals
Ffine-grained pink sienogranite	IB7	Quartz 35%, pPotassium Feldspar 35%, plagioclase 25%, biotite 5%	Apatite, zircon
Bbiotite icbearing pink granite	IB28	Quartz 35%, pPotassium fFeldspar 25%, plagioclase 30%, biotite 10%	Apatite, zircon
Ppink alkali-feldspar granite	IB9	Potassium feldspar 50%, quartz 30%, plagioclase 5%, green amphibole 10%, sodic amphibole 5%	Ssphene
Ppink alkal-ifeldspar granite	IB10	Potassium feldspar 50%, quartz 30%, plagioclase 5%, green amphibole 10%, sodic amphibole 5%	Ssphene
Granodiorite	IB6	Quartz 20%, plagioclase 25%, potassium feldspar 5%, green amphibole 30%, biotite 20%	Apatite, zircon, sphene, opaque minerals
Granodiorite	IB4	Quartz 25%, pPlagioclase 15%, potassium feldspar 10%, biotite 30%, green amphibole 20%	Ssphene, apatite
Quartz-odiorite	IB8	Quartz 10%, pPlagioclase 40%, green amphibole 30%, biotite 20%	Apatite, sphene, rutile, opaque minerals
Tonalite	IB3	Quartz 15%, plagioclase 30%, potassium feldspar 5%, green amphibole 30%, biotite 20%,	Ssphene, apatite, rutile, opaque minerals
Tonalite	IB12	Quartz 15%, plagioclase 30%, potassium feldspar 5%, green amphibole 30% biotite 20%	Ssphene, apatite, rutile, opaque minerals
Gabbro	IB15	Plagioclase 45%, olivine 35%, pyroxene 15%, nepheline 5%	/
Nubian sandstones	IB19	Quartz 70%, fine grain matrix 8%, white mica 2-3%, porosity 20%	Tourmaline
Nubian sandstones	IB20	Quartz 65%, white mica 2-3%, potassium feldspar 2-3%, fine grain matrix 10%, porosity 20%	Tourmaline, Zircon, Rutile, opaque minerals
Mmeta-sandstones of Gebel Ahmar	IB16	Quartz 75%, cement rich in iron oxides 10%, porosity 15%	/
Mmeta-sandstones of Gebel Ahmar	IB17	Quartz 75%, cement rich in iron oxides 10%, porosity 15%	/

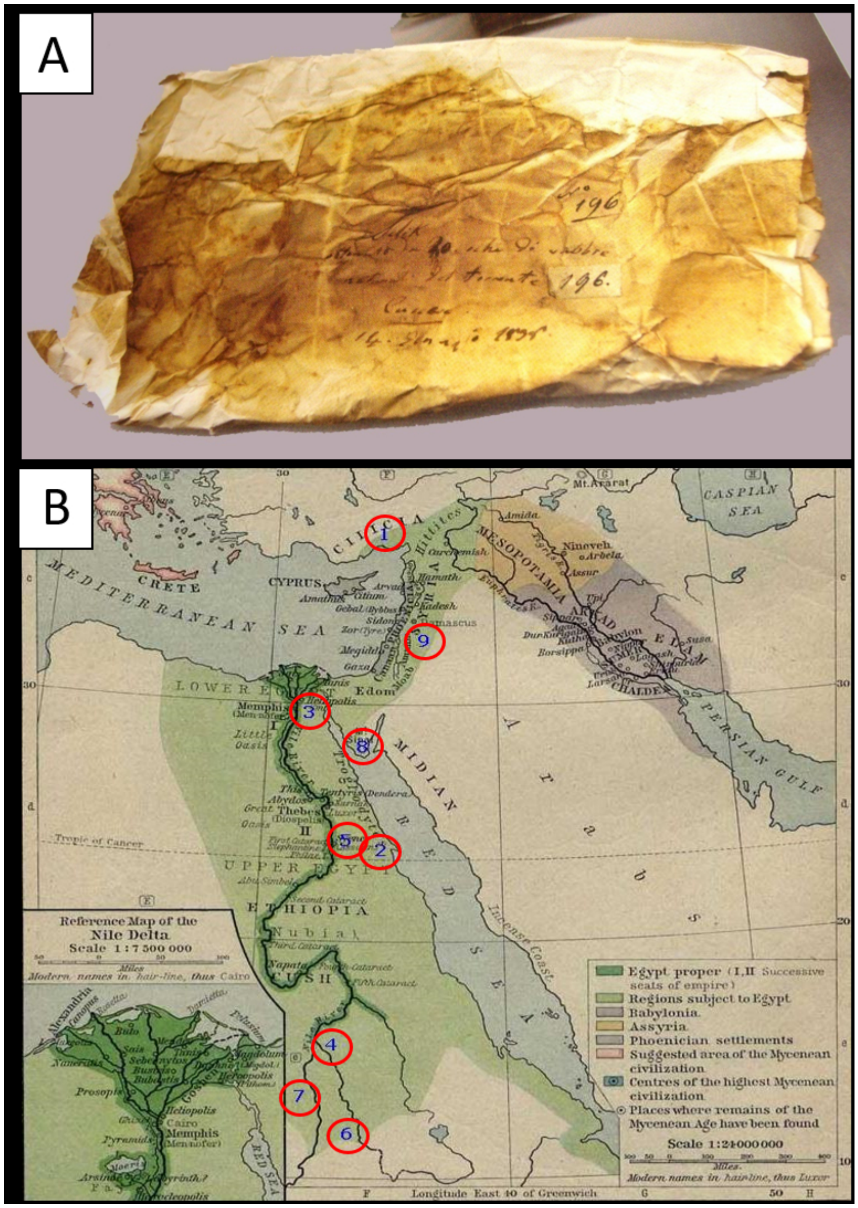


Fig. 1 - A: The paper package which contained a sand specimen and which bears the only date found (January 14, 1838), (from Barale et al., 2014); B: Sites of origin of the samples of the collection. 1. Taurus Mountains; 2. Mount Bérénis; 3. Red Mountain; 4. Nil Bleu; 5. Aswan; 6. Fazouglou; 7. Kordophan; 8. Mount Sinai; 9. Syria. From http://www.ancient-egypt-online.com/images/ancient-egypt-map.jpg, modified

130x183mm (150 x 150 DPI)

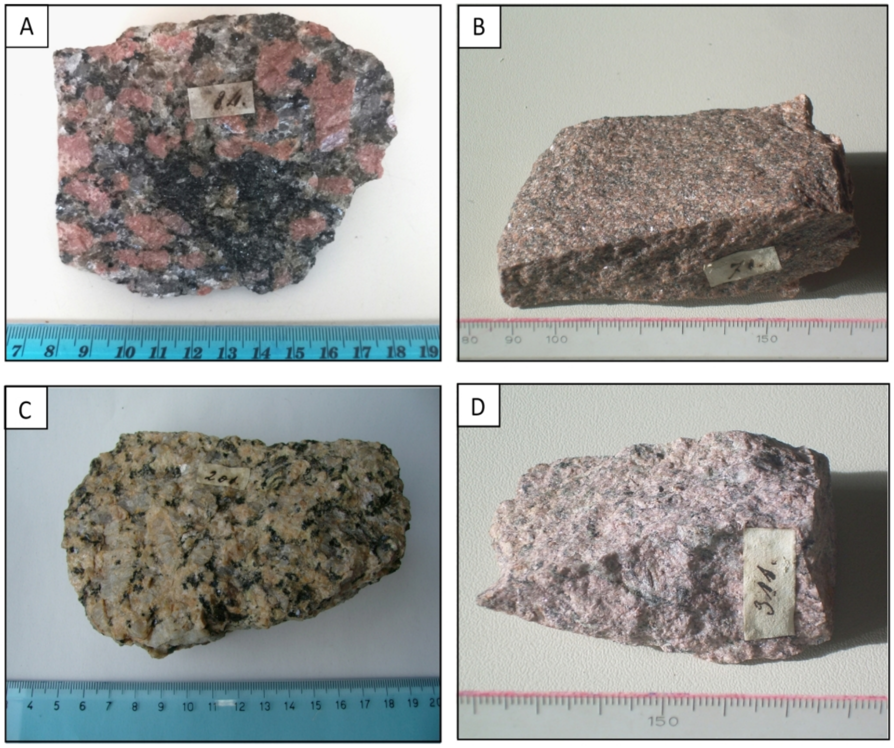


Fig. 2 - Representative sample of red and pink granite. A: monumental pink granite, B: fine-grained pink sienogranite, C: biotite bearing pink granite, D: pink alkali-feldspar granite.

187x154mm (300 x 300 DPI)

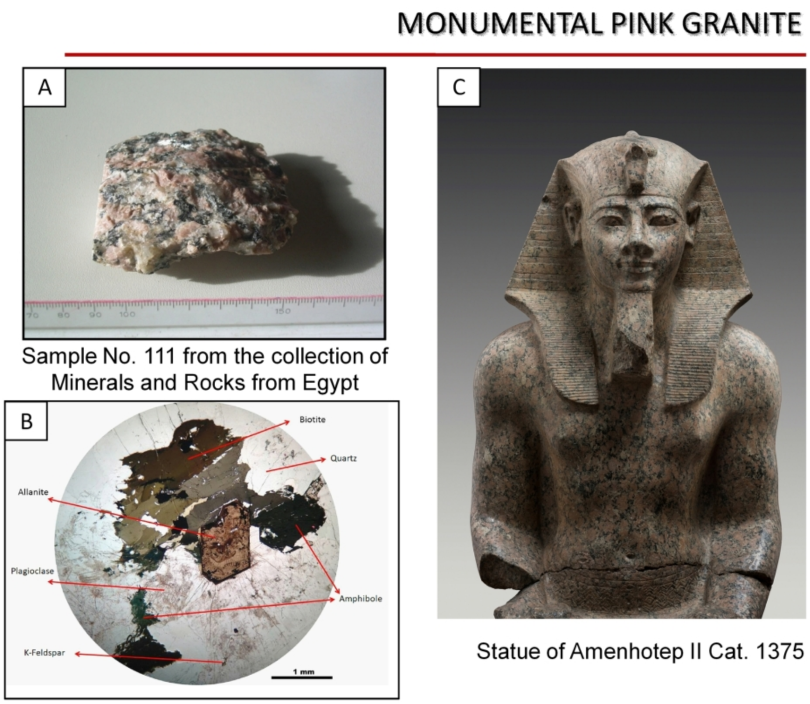


Fig. 3 - Monumental pink granite form. Macroscopic (A) and microscopic (B) image of Sample No. 111 from the collection of Minerals and Rocks from Egypt; C) Statue of Amenhotep II exposed at the Museo Egizio of Turin (cat. 1375).

184x137mm (300 x 300 DPI)

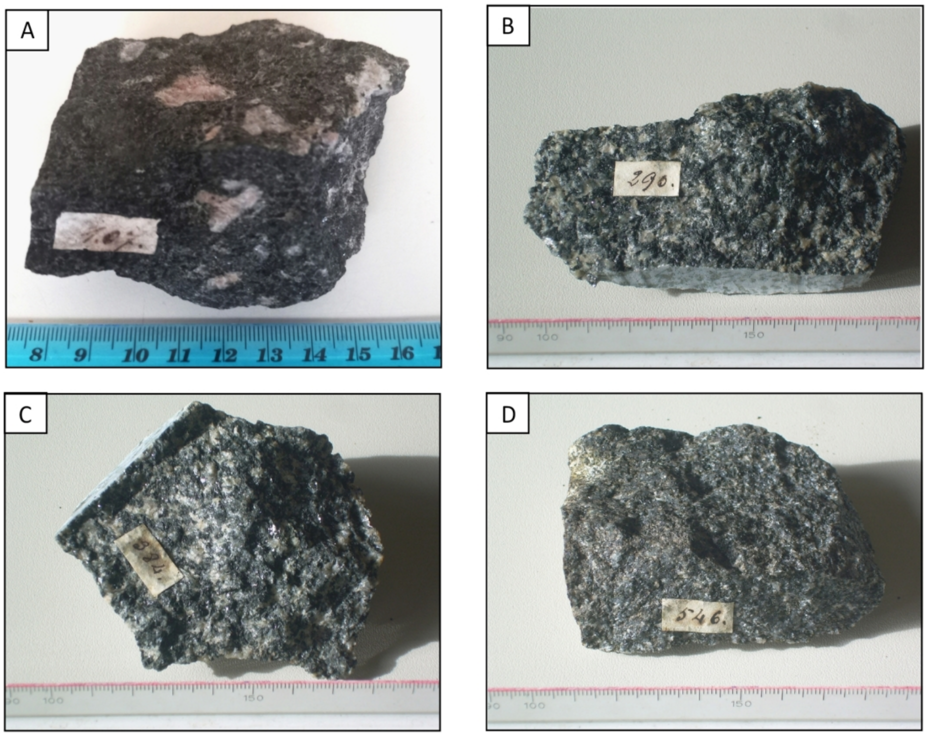


Fig. 4 - Representative samples of black granite. A: porphyritic granodiorite , B: quartz-diorite, C: Tonalite, D: gabbro

177x138mm (300 x 300 DPI)

Fig. 5 - Granodiorite form. Macroscopic (A) and microscopic (B) image of Sample No. 107 from the collection of Minerals and Rocks from Egypt;Goddess of Medicine Sekhmet (standing, 247 and sitting, 251) exposed at the Museo Egizio of Turin (cat. 247, 251).

198x151mm (300 x 300 DPI)

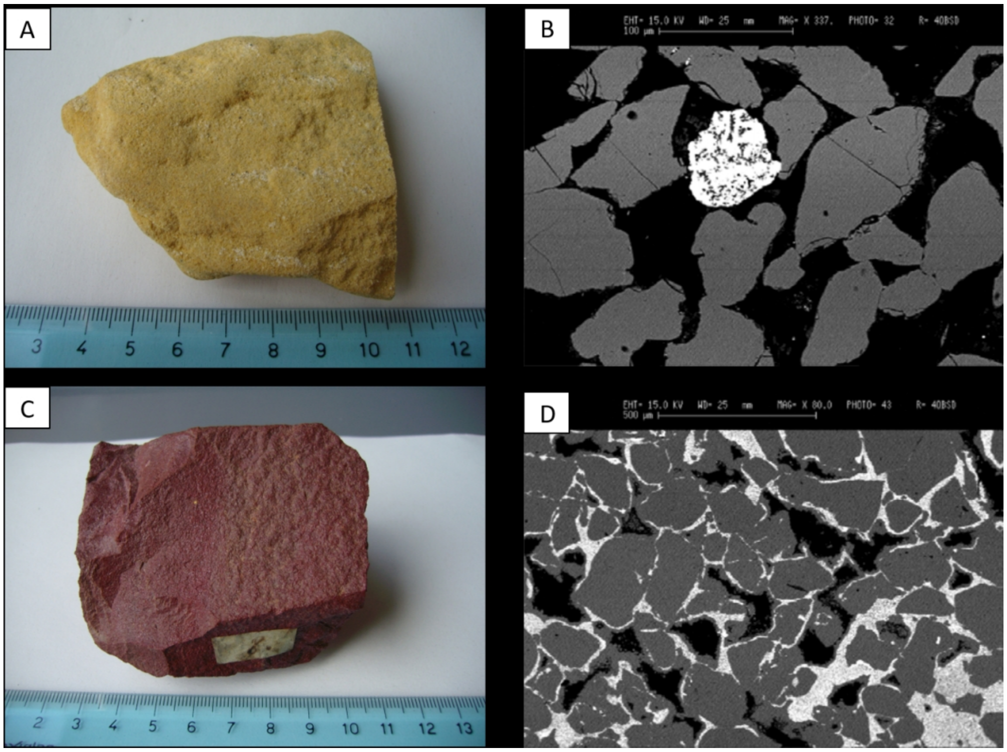
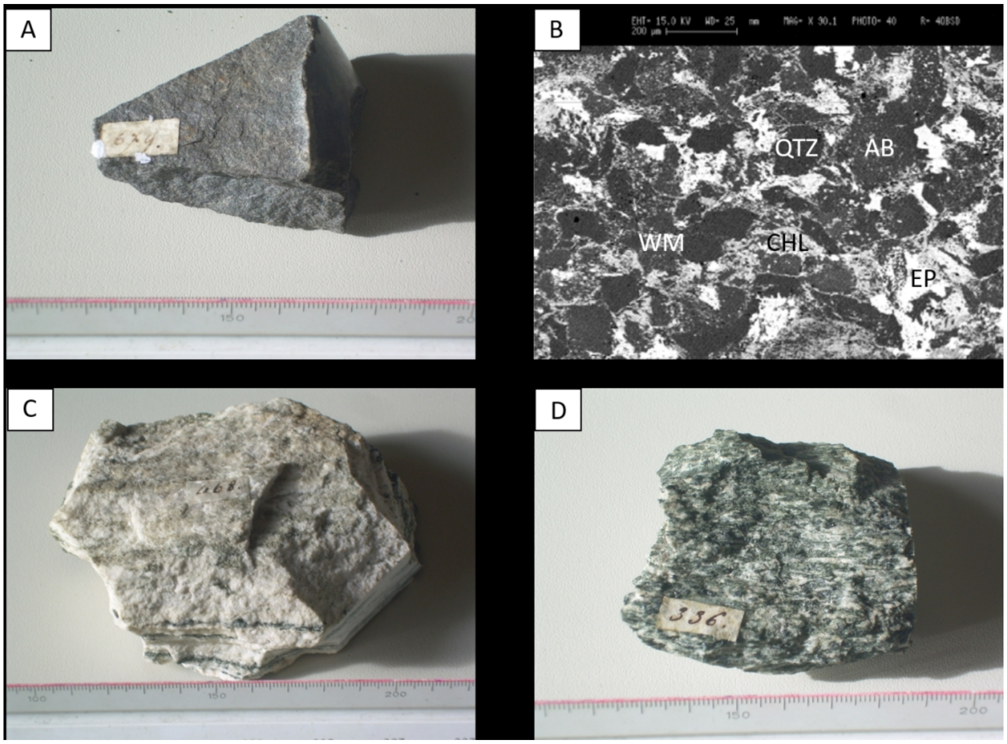


Fig. 6 - Representative sample of sedimentary rocks. A: Nubian sandstone, B: detail of the texture of the sandstone, in which quartz clasts, a fine matrix and abundant porosity are observed. In the center of the image is a staurolite clast. SEM image in backscattered electron mode; C: Gebel Amar meta-sandstone, ; D: detail showing the quartz clasts surrounded by a secondary cement rich in iron hydroxides, SEM image in backscattered electron mode

238x177mm (150 x 150 DPI)



.Fig. 7 - A: macroscopic image of the Bekhen Stone; B: microscopic appearance of the rock, characterized by sub-rounded clasts of quartz and albite immersed in a phyllosilicate matrix of white mica, chlorite and epidote. SEM image in backscattered electron mode. AB: albite; CHL: chlorite; EP: epidote; QTZ: quartz; WM: white mica

235x173mm (150 x 150 DPI)

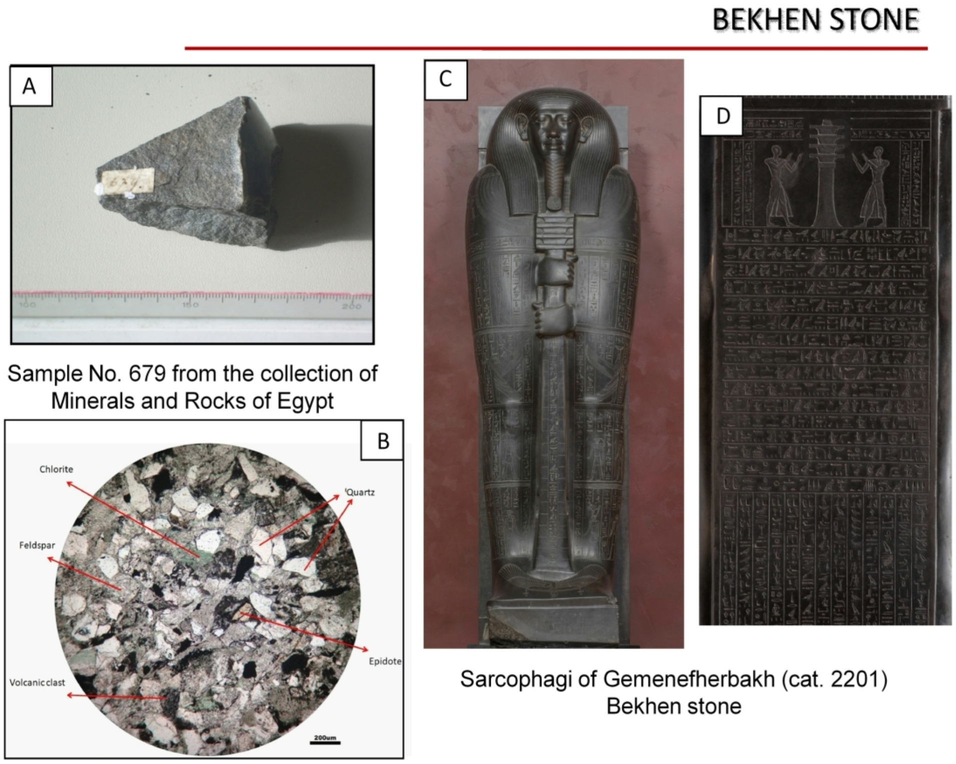


Fig. 8 - Bekhen Stone form. Macroscopic (A) and microscopic (B) image of Sample No. 679 from the collection of Minerals and Rocks from Egypt; C) Sarcophagi of Gemenefherbakh, and D) Ibi Shepmin (cat. 2202 and 2203) exposed at the Museo Egitto of Turin (cat. 2202, 2203).

193x148mm (300 x 300 DPI)