GARNET STONE OCCURRENCES IN KESKİN-ÇELEBİDAĞ REGION

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ABSTRACT. —- During the study of tungsten (scheelite) occurrences in Çelebidağ region of Keskin, garnet stone was encountered inside the skarn (tactite) zones. They were formed at the contact between granodiorite batholith and cipolin marbles. These garnet stones, found approximately one km west of Çelebiköy, are typical contaet-metamorphic and pyrometasomatic rocks. The genesis of garnet stones at Hacet Tepe forms a unit with other contact-metamorphic rocks. Mineralogically two subfacies are distinguished : a) grossularite stones, b) andradite stones.

Garnet which is considered a valuable natural abrasive has been successfully used in the industry. One of the things required in garnets is hardness. Laboratory tests run for grossularite and andradite have shown their hardness approximately to correspond to 7 on the Mohs scale. On the New York stock exchange market a ton of garnet concentrate sells for about $ 85.

INTRODUCTION

This article has resulted from geological work carried out in the region of Çelebidağ. The main purpose of this study, in 1957, was to,determine whether or not an important mineralization was caused by the skarn zones in the said region. Preliminary geological studies of the region were taken up by W. Burchardt. This was later followed by our own detailed work covering all contact - metamorphics showing garnet stone facies within skarn zones. Seen with the naked eye, these garnet stones appear to be rather coarse-grained, in beautiful dark-red and dark-green colors. These occurrences, easily picked out from among the other skarns, cover rather a large area west of Çelebiköy and at Hacet Tepe. Subsequent drillings showed the thickness of these occurrences to run from 5-10 meters.

GEOLOGY

Geological structure of the Çelebidag region is more or less simple. This region forming the western section of the Kırşehir massif is bordered in the west by the river Kızılırmak. Stratigraphically and geologically, the following units may be distinguished :

a) White cipolin marbles, probably of Upper Paleozoic age, b) granite and granodiorite massifs possibly older than Upper Cretaceous, c) Cretaceous series containing spilite, radiolarite, limestone and marly limestone, d) gabbro and spilitic series with outcrops east of Tatik köy, e) contact-metamorphic skarn formed between granite and granodiorite batholith and marbles, f) Neogene series comprising conglomerates, sandstones, marls and argillaceous marls (see geologic map of the region).

a) No paleontological evidence was ever encountered in cipolin marbles. They contain muscovite, sericite and rarely biotite. They occur pure white in color and have larger grains along granite contacts. This can be explained by the recrystallization and regeneration of the marbles in these contact zones. Marbles and quartz-schists enclaved in these marbles constitute the primary

rocks of these skarns. The marbles, especially the ones at Körpınar, bear iron deposits of sedimentary metamorphic origin.

b) Granite and granodiorite batholith outcrops over a rather large area. Certain parts of this batholith show alterations ranging up to quartz-monzonite. The fact that this batholith was brought to the surface implies the persistence of an emersion phase over the greater part of the Tertiary, as it is further shown by the existence of Tertiary sediments. Post-intrusion tectonics which took place during the settling and cooling period of the batholith is best observed in cipolin marbles. Small systems of diaclases and paraclases also testify for these tectonic movements.

c) Upper Cretaceous series is well formed, especially near Halildede köy. Radiolarite and spilite rocks predominate in this series. Several species of *Globotruncana* microfossils have established the age of this series to be Upper Cretaceous. In this series spilites are more or less concordant with other sedimentary rocks and undoubtedly belong to the Upper Cretaceous.

d) The tectonics and the stratigraphy of the gabbro and spilite formations with outcrops east of Tatik köy are not known. The disposition of these basic intrusions and partially submarine effusions have not been explained.

e) The most important of the mineralogic facies encountered in the skarn zones at the contact between «cipolin» marbles and granite and granodiorite batholith are : tremolite-actinolite-diop side stone, epidote-tremolite-diopside stone, tremolite-garnet-epidote stone, tremolite stone and garnet stones.

The minerals most frequently occurring in the skarns are: garnet, diopside, epidote, .tremolite-actinolite, quartz, calcite, magnetite, pyrite specularite, hematite and rarely chalcopyrite plus a little scheelite.

Skarns along the granite contacts do not show regular outcrops. Moreover many of the contacts are free from skarn. Outside of some of the exceptional cases, skarn zone in general is about 10 m thick. Some of the skarns have a thickness of only one meter. Within a 20 square kilometer-area, where «cipolin» marbles outcrop, the majority of the skarn zones are enclaved by these marbles. The geology of these enclaved skarns with marble foot- and hanging walls is rather complicated. In most cases, skarn zones do not show any relation with granite and granodiorite batholith. The explanation to such situations must lie with the post-intrusion tectonic movements. The thickness of the marbles, strongly eroded, is not more than a 100 meters on the average.

Characteristics of the garnet stones at Hacet Tepe. — Garnet stones which occur at Hacet Tepe constitute, as a whole, a sub-facies of the skarns found in this area. Under microscope, rock samples show a 90 % garnet content. Main mineral in this rock is grossularite. In some sections grossularite does not show any zone structure and optical anomaly. Among the secondary minerals biotite, muscovite and very little quartz, calcite, chlorite, magnetite and limonite may be cited. Chlorite depends on the chloritization of the biotite. Calcite occurs in large crystals and, in some sections, in twins.

Andradite is the constituent mineral in andradite stone. Secondary minerals being calcite, quartz with a little pyroxene and limonite.

Grossularite stone is considered to come from marble. As for andradite

stones, it is observed that they originate through pyrometasomatosis of the quartz - schists enclaved within the marbles.

The hardness of these garnet stones was tested in laboratories of the M.T.A. Institute, the results being 7.3 for andradite and 6.7 for grossularite on the Mohs scale. The grain size of the grossularite stone varied between 0.5-1 cm, whereas the grain size of the andradite stone remained less than 0.3 cm.

Garnet stone reserves arc not extensive. Although their outcrops cover rather a large area at Hacet Tepe, pure garnet stone occurrences are limited. Probable reserves were estimated to aggregate approximately 0.5 million tons.

General information on the production and utilization of garnet. — Before it is used in industry, garnet is ground from 15 to 200 mesh. Some 10 500 tons of garnet were mined in the United States in 1955. There is no garnet mining in Turkey. However, 1280 tons of emery products were imported into this country during 1953-1954. Similar products kept coming in later years as well.

Natural abrasives—garnet and emcry—which can compete with artificial ones, are mined in several countries. In Spain, district of Almeria, garnet is produced from alluviums at a yearly rate of about 3000 tons. U.S.A., India, Canada, Madagascar and Czechoslovakia arc among the producing countries.

In the states of New York, New Hampshire and North Carolina, U.S.A., garnet is produced from metamorphic schists, rock content varying from 20 to 80 percent.

CONCLUSION

The object of this article is to note the economic importance of garnet stones. These occurrences arc likely to be encountered in many places in Turkey. One must especially look along the contact zones of asidic intrusive rocks for such occurrences. The country's future needs may partially be met from these deposits. The use and marketing of garnet concentrates, 95-98 % pure, to be obtained in the course of the treatment of the Uludağ schcelite ore is under consideration. As the grain sizes will run between 15 to 180 mesh, marketing possibilities of this by-product are well worth considering.

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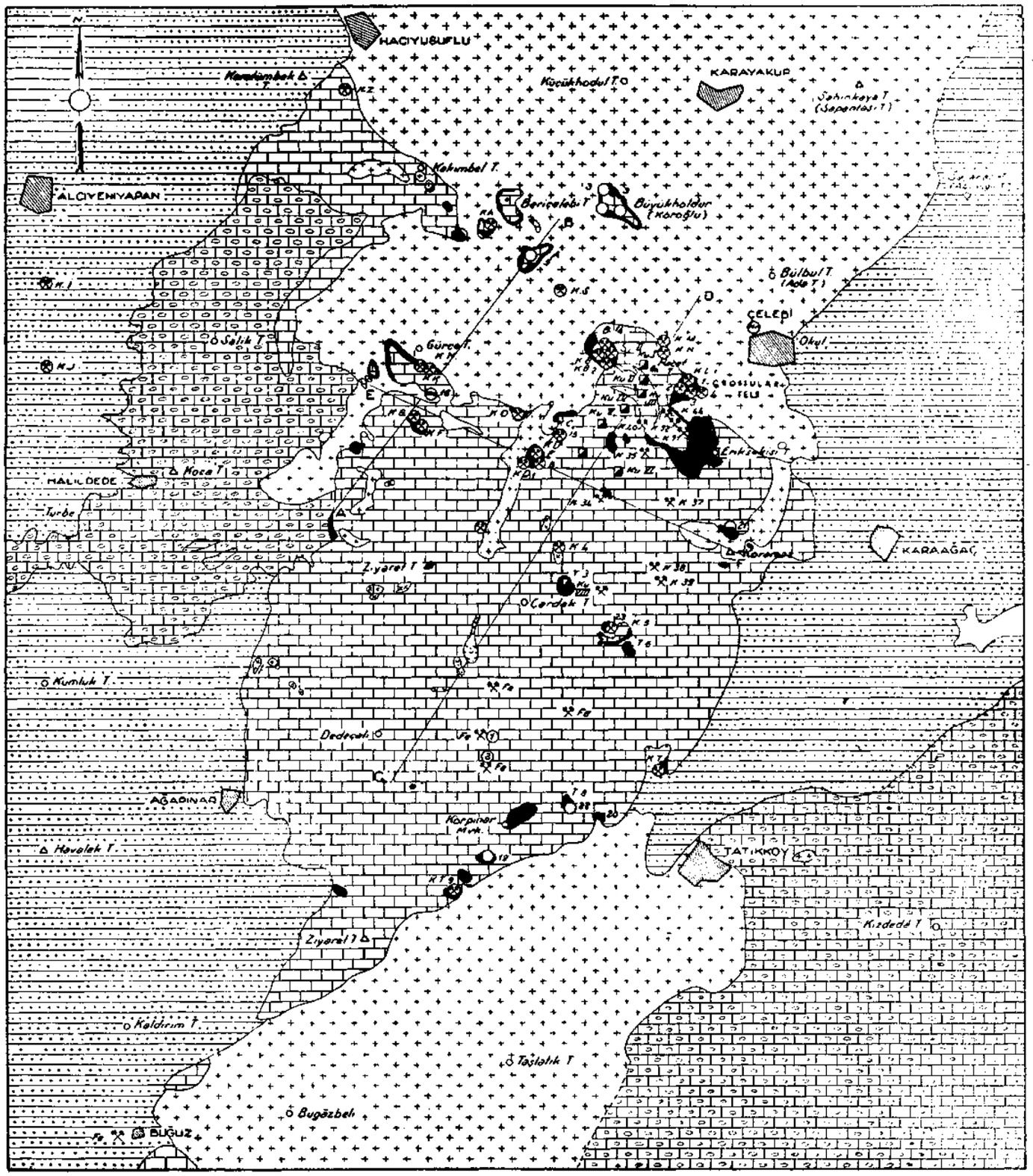
GEOLOGIC MAP OF ÇELEBİ REGION



Alluvium

Neogene series (conglomerate, sandstone, shaly sandstone)

Upper Cretaceous series (spilite, radiolarite, etc.)

Marble (cipolin)

Iron mineralization

Excavation

Scheelite outcrops (studied by excavation)

Geologic sections

Dip and strike

Gabbro and basic intrusive rocks

Amphibolite

Granite (partly granodiorite)

Quartz monzonite

Tactite zone

Quartzification and sericitization

Schists with quartz, partly garnetitized