CONTACT METAMORPHIC SKARNS IN CALC-GRANULITE AT GARIVIDI, SRIKAKULAM DISTRICT, ANDHRA PRADESH

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Introduction: During the course of detailed mapping of the Vizagapatam manganese belt in southern Srikakulam district, Andhra Pradesh, the geology and interrelationship of the rock types in the Koduru–Garividi area, the type area of Fermor's Kodurite series, were studied with special reference to the manganese deposits and associated calc-granulities. The granites and granite pegmatites, which traverse through the calc-granulites of the khondalite formation, have produced contact metamorphic effects on the latter. Some remarkable contact metamorphic skarns are developed in the calc-granulites exposed in the small hill to the north of the ferromanganese factory adjoining Garividi (at present Sreeramanagar) R.S. This paper presents the results of preliminary studies on the skarn rocks from the Garividi hill.

Geology of the Garividi area: Garnet-sillimanite gneisses (khondalites), calc-granulites crystalline limestones, garnet granulites and associated manganese-ore bodies are the rock types in the area. All these rocks have been highly folded and faulted. The folds plunge in an ESE direction at an average angle of 25°, as evidenced by the drag-fold lineations. The drag folds are best exhibited by the calc-granulities. All the rocks in the area exhibit good joints, trending NNE–SSW and WNW–ESE. Granite and granite pegmatites are found to follow these joint planes in the calc-granulite hill, NNE of Garividi R. S. Granite plutons have been mapped in the area to the north and south of the calc-granulite hill under description.

It has been found that all along the contact of the calc-granulite with the granite pegmatites, which are on an average about two metres thick, there is a skarn zone of about 4 cm wide. The granite contains large grains of dark green diopside for a width of about 15 cm. However, the contact between the calc-granulite and pegmatite appears quite sharp. Microscopic studies have revealed that contact metamorphism has resulted in marked changes in the mineralogy, modal composition and the grain size of the calc-granulites. The normal calc-granulite has a grain size varying from 0.25 mm to 0.5 mm whereas the grain size in the skarn zone varies from 1 mm to 2 mm. Diopside grains of 5 mm size are not uncommon in the recrystallised zone.

Petrography: The pegmatite is a very coarse grained pink rock with the modal composition of 66.98 per cent microcline, 19.10 per cent quartz and 13.33 per cent orthoclase. The accessory minerals found are a few grains of muscovite and apatite, and in the zone nearer the contact with the calc-granulite a few grains of diopside and calcite. Apatite is in small grains and mostly in association with quartz.

The skarn zone is divided into two zones – (a) close to the granite and (b) close to the calc-granulite for purposes of detailed description. Similarly the calc-granulite has been divided into two zones – (1) close to the skarn zone and (2) away from the skarn zone.

The calc-granulite in zone 2 is found to have the following modal composition:

Scapolite	....	42.02%
Diopside	....	31.69%
Quartz	....	21.06%

Sphene	....	1.61%
Calcite	....	2.02%
Opaques	....	1.12%

Optical determinations show that scapolite is of mizzonite variety (Ma_{50} Me_{50}), with refractive indices of N_O 1.577 and N_e 1.552, and diopside of high iron ferrosalite variety with β index of 1.717.

This calc-granulite compares very favourably with the other calc-granulites in the area, which show roughly similar percentages of the minerals. In none of the rocks plagioclase or any other felspar was noticed.

There is a slight difference in the modal composition and the nature of the scapolite in zone 1, which is nearer the recrystallised skarn zone. The modal composition of the calc-granulite in this zone is:

Scapolite	....	43.00%
Quartz	....	22.9%
Diopside	....	20.5%
Wollastonite	....	5.5%
Calcite	....	3.5%
Sphene	....	2.2%

In this zone the opaques disappear and a few grains of microcline appear. Apatite, which occurs as small grains in zone 2, still occurs in this zone, but with the difference that a few more grains than in the former are noticeable. Wollastonite makes its appearance. The scapolite in this zone has a birefringence of 0.023, with refractive indices of N_O 1.576 ± 0.002 and N_e 1.553 ± 0.003. This shows that there is a change in the composition of scapolite, which moves towards the meionite end of mizzonite variety (Ma_{35} Me_{65}).

There is a great change in the modal composition and nature of the diopside in the recrystallised skarn zone in that the modal composition of the zone 'b' in the recrystallised rock is:

Plagioclase	....	60.8%
Diopside	....	37.8%

Occasional grains of quartz and big grains of apatite form the rest. A few small grains of sphene also occur. Plagioclase, which was absent in the zone '2' in calc-granulite, forms the major part of the rock.

The modal composition of the recrystallised coarse-grained granulite in zone a' at the contact of the granite is:

Plagioclase	....	58.4%
Diopside	....	28.9%
Quartz	....	11.8%

In this zone sphene is completely absent and apatite is seen quite prominently as big grains. A few grains of diopside partly breaking into calcite and orthoclase are found.

The diopside in the recrystallised zone is found to be low-iron ferrosalite variety, with β index of refraction 1.712 ± 0.003. The plagioclase is found to be of andesine variety. Detailed studies on the exact composition of the plagioclases are in progress.

Discussion: It is clear from the above data that there is a marked change in the

grain size, modal composition and mineralogy of the calc-granulite at the granite contact. The skarn rock is coarser grained than normal calc-granulite. There is a complete change in the mineralogy and modal composition of the skarn rock, in that scapolite and quartz, which make up nearly 40 per cent and 20 per cent respectively in the normal calc-granulite have completely disappeared and have been replaced by plagioclase of the composition andesine, which now makes up about 60 per cent of the rock. Sphene, which is in noticeable proportion in the calc-granulite, is present only in very minor amounts in zone 'b' and is completely absent in zone 'a' near the pegmatite contact. Apatite, which is present in very minor proportion and as tiny grains in the calc-granulite, has slightly increased in amount and occurs as larger grains in the skarn rock. The change in diopside is decrease in the β index of refraction, relegating that in the skarn rock to the low-iron variety of ferrosalite. There is also addition of alkali felspars and quartz in the skarn rock near the contact with pegmatite. The most notable effect is, therefore, conversion of scapolite of intermediate variety into andesine plagioclase, disappearance of quartz, sphene etc., and increase in the proportion of apatite.

The above reaction, which shows conversion of scapolite into plagioclase, is endothermic, and is uncommon. The author has not come across any references describing the above contact metamorphic development of plagioclase from scapolite. Scapolitisation is a common phenomenon in the calc-silicate rocks. Barth (1952), however, mentions that in some Precambrian rocks of Southern Norway calcic scapolite and sodic plagioclase are in equilibrium at intermediate temperatures. He further says that at higher temperatures solid plagioclase is stable. In this case the host rock is rich in calcium and contains sodic scapolite. It is likely that at the temperatures that are normal with intrusion of granite, the stability conditions of scapolite are changed and plagioclase has developed. However, diopside remains stable although its composition has slightly changed. The chlorine released during recrystallisation appears to have gone into the formation of apatite. In the zone nearer the granite pegmatite contact, quartz and orthoclase have been introduced from the granite. The development of plagioclase from scapolite in the skarn rock at Garividi thus suggests that under special conditions, the reverse change from scapolite to plagioclase is possible at higher temperatures and the reaction is reversible. A detailed petrological and chemical study of the skarn rock is in progress.

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