CARBONIC AND HALITE BEARING FLUIDS IN GRANULITES AND GRANITES FROM SATNURU-HALAGURU, DHARWAR CRATON, SOUTHERN INDIA.

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Abstract

High density carbonic (1.075 to 1.050 g/cc) fluids coeval with high salinity aqueous fluids (29 to 33 wt.% NaCl eqv.) are the characteristic fluids in the Precambrian Satnur-Halaguru granulites, southern India. Highly saline fluids have also been recorded in the spatially associated Closepet granites. Record of ubiquitous highly saline fluids both in the granulites and granites suggest a close genetic link between these two rock type. Highly saline fluids have played an important role in deepcrustalgranulite facies metamorphism and granite genesis in the Dharwar craton

Keywords: *CO_2 and Aqueous Fluids; Granulites; Granites; south India*

Introduction

Fluid inclusion study in granitic rocks is important as they provide information on the nature and composition of fluid phase present in felsic magmas. Experimental work on granites has indicated that H_2O to be the most common fluids (Wyllie et al., 1976). However, recent studies on fluid inclusions in many deep seated granitic intrusions from Precambrian terrane has indicated the presence of CO_2 and CO_2-H_2O inclusions, apart from H_2O inclusions (Nebelese and Jernes, 1997 and references therein). Carbonic fluids present in granulites were taken as evidence for the stability of dry mineral assemblages in high-grade metamorphic rocks in contrast to water dominated fluids in lower-grade metamorphic rocks. In south Indian granulites, presence of CO2-rich fluids have been reported (Janardhan etal., 1982; Srikantappa etal.,2002), suggesting widespread carbonic metamorphism. However, brine inclusions associated with CO_2-rich inclusions have been well documented from other granulite terranes like Bamble in southern Norway (Touret,1985) and Limpopo Belt in south Africa (Smith and Van Reenen, 1997). Significance of hypersaline fluidsin deep crustal metamorphism has been emphasized recently by Newton et al., 1998.

In this paper, we report for the first time presence of highly saline fluids associated with carbonic fluids in the Precambrian Satnuru-Halguru granulites as well as in the spatially associated Closepet granites.

Geological setting

Massive to banded opx-bearing quartzo-feldspathic gneisses (termed as charnockites) of tonalitic composition are the predominant rocks exposed around Satnuru-Halguru in southern part of the Dharwar craton, south India. The rocks show regional trend of N-S with steep

dips. Granulites show migmatization with leucosomes containing quartz-feldspar segregations. Granulites are interbanded with grey coloured foliated gneisses which have been migmatised and intruded by Closepet granite (Moyen et al., 2003). Granulites show spatial association with Closepet granite suggesting near-contemporaneity of their formation (Janardhan et al, 1982). The P-T conditions of granulites facies metamorphism range from 5 - 7 Kb at ~ 700 to 740^{o}C. The granulite facies metamorphic ages are 2.51 to 2.55 Ga which is synchronous with the emplacement age (2.5 to 2.6 Ga) of Closepet granites (Moyen et al., 2003). Both granulites and granites have been cut by late E-W and N 45^{o}E trending ductile shears.

Samples of granulites for this study were collected from an active quarry near the village "Kunkundoddi" SW of Halaguru. In this quarry, orthopyroxene-bearing quartzofeldspathic gneisses show well developed foliation trending NS with steep dips of 85° towards east. Presence of quartz- feldspar-bearing leucosomes is observed, which occur parallel to the regional foliation. Medium grained melanocratic mafic granulite consisting of clinopyroxene, hornblende and plagioclase occur as parallel bands within the orthopyroxene-bearing quartzofeldspathic gneiss giving banded appearance to the rock.

In thin section, quartz occur as both primary as well as recrystallized rains withcoarse to fine grained texture. Quartz show myrmekitic texture in contact with feldspar grains. quartz grains show straight boundary contact with hypersthene and rarely show stretching and undulose extinction.

Euhedral hypersthenes occur interstitial to quartz and plagioclase grains and show no alteration. Presence of quartz and brownish biotite is seen as inclusions in hypersthenes indicating its formation during prograde metamorphism by the following reaction;

Biotite + quartz -→ hypersthenes + K-feldspar + H2O↑

Quartz inclusions in hypersthene show rounded to smooth grain boundaries. Plagioclase show well developed twinning and exhibit alteration along cleavage planes to sericite and talc.

Fluid inclusion study

Fluid inclusion study was carried out on granulites, Closepet granite and in coarse grainedporphyritic monzogranite. The following four types of fluid inclusions have been recorded in these rocks:

Type I: Halite bearing inclusions
Type II: CO2 - inclusions
Type III: Low salinity aqueous inclusions and
Type IV: Empty inclusions

Fluid inclusions occur either as isolated clusters or as intragranular trail bound inclusions in quartz grains. They vary in shape from rounded to oval of varying size with CO2 inclusions generally showing negative crystal shapes (Fig.1). The size of halite bearing(Fig. 2) and low salinity aqueous inclusions vary from 5 to 10 µm and CO2 inclusions from 5 to 14 µm. Presence of intragranular, trail bound both saline and CO2 -fluids within a single quartz grain in granulites indicate to their simultaneous entrapment. Fluids in Closepet granites and pegmatites are generally larger in size when compared to granulites.

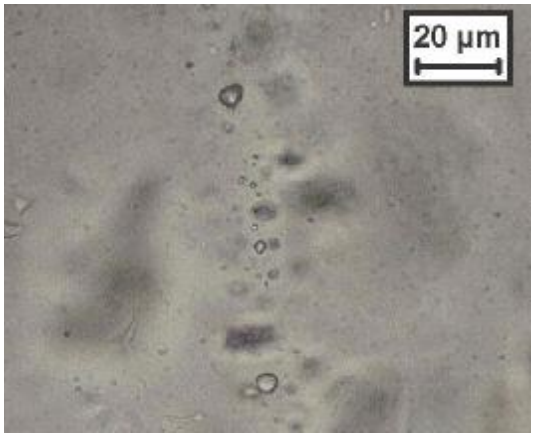

Fig. 1. Monophase, trail bound CO_2-rich inclusions in quartz from granulites

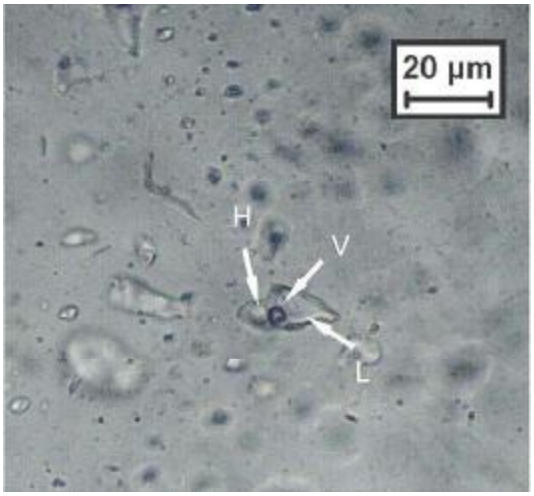

Fig. 2. Isolated, halite-bearing fluid inclusions in quartz grain from granulites
H:Halite, V: H2O Vapour; L: H2O Liquid