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Chloritoid schists from NE Sardinia: pressure and temperature evolution inferred from compositional zoning in garnet and potassic white mica

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Chloritoid schists crop out a few kilometers north of the village of Lula in the Axial Zone of the Variscan chain of Sardinia. The basement of this zone mainly consists of quartzite, mylonitic schist, paragneiss, orthogneiss and augen gneiss. The chloritoid schists belong to the garnet zone of the barrovian sequence of NE Sardinia (Franceschelli et al., 1982).

The S_1 foliation is defined, in microlithons, by the orientation of muscovite, paragonite, chloritoid, quartz, and Fe-oxides. Garnet porphyroblasts enclose quartz, chloritoid, rutile, Fe-oxide, apatite and paragonite. S_2 minerals include paragonite, muscovite, chlorite and chloritoid. Margarite growing on chloritoid also occurs.

Garnet porphyroblasts show a progressive decrease of spessartine (from 17 to 7 mol%) and an increase of pyrope (from 4 to 6 mol%) from core to rim. Almandine varies from 57-58 mol% in the garnet core to 70-72 mol% in the rim. The grossular content firstly increases from the inner (∼21 mol%) to the outer core (∼27 mol%) and then decreases towards the outermost rim (∼15 mol%). X-ray mapping of white mica revealed compositional zoning and a wide range in Si content (from 6.0 to 6.6 a.p.f.u.). Contents of Fe, Mg, and Na are between 0.10-0.30 a.p.f.u., 0.10-0.60 a.p.f.u. and 0.12-0.45 a.p.f.u., respectively. The highest Si content is related to the highest Fe and Mg contents and the lowest Na content. The sum of interlayer cations (K+Na+Ca+Ba) varies between 1.55 and 1.85 a.p.f.u. and shows a negative correlation with the Si content. The X_{Mg} of chloritoid is between 0.15-0.17. Chlorite shows Al^{IV} in the range 2.5-2.8 a.p.f.u. and X_{Mg} in the range 0.41-0.48.

Calculations with PERPLE_X (Connolly, 2005), using the data set of Holland & Powell (1998 and updates) were performed in the system Na_2O-K_2O-CaO-FeO-MnO-MgO-Al_2O_3-TiO_2-SiO_2-H_2O in order to improve our knowledge on the P-T evolution of the chloritoid schists. The obtained P-T pseudosections were contoured by compositional isopleths for grossular, almandine, pyrope, spessartine in garnet, Si in white mica and X_{Mg} in chloritoid.

The highest Si contents of potassic white mica and the garnet core composition suggest pressures close to 17kbar and T= 470-500˚C. The garnet rim composition is compatible with re-equilibration at 540-570˚C and 7-10 kbar. These results suggest an HP-metamorphic imprint before the barrovian amphibolite-facies metamorphism of NE Sardinia.

Connolly, 2005. Earth Planet. Sci. Lett. 236, 524-541.

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