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Indications for aqueous CH_4-bearing excess fluid during HP-metamorphism in subduction zone eclogites of the Raspas Complex, Ecuador

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To get a better understanding of the role of fluid phases in subduction settings, the knowledge of the composition and fluid/rock ratio of high pressure fluids is a prerequisite. Fluid inclusions are preserved relics of the fluid present at different stages during the subduction cycle and thus the only direct evidence for the original paleofluids.

Fluid inclusion investigations have been obtained in eclogites of the Raspas Complex in Ecuador. Associated with the eclogites are metapelites, blueschists and partly serpentinized peridotites (Gabriele et al. 2003, Eur. J. Min. 15: 977-989). The complex is regarded as a metaophiolite, representing oceanic lithosphere subducted to a depth of about 70 km.

Geochemically different protoliths can be assigned to the eclogites: MORB, OIB and metasomatized eclogites which are cut by zoisite veins representing former fluid pathways. In all the geochemically different eclogite types, primary fluid inclusions could be investigated in omphacite, zoisite, garnet and quartz.

Preliminary results from microthermometry and Raman spectroscopy on primary fluid inclusions in the eclogite-facies minerals yield a rather homogeneous fluid composition in the system H_2O–NaCl–CH_4. Raman spectroscopy combined with a heating-freezing stage allow to define the melting temperatures of ice and CH_4-clathrate giving a low salinity for these primary fluid inclusions. A consistent volume fraction of the

vapour bubble in all primary inclusions in the eclogite-facies minerals indicate homogeneous entrapment. The majority of fluid inclusions also contain tiny solids and most of them have been identified as calcite by Raman spectroscopy. In a mm-thin eclogite-facies zoisite vein, beside the previously mentioned inclusion type, a second type of fluid inclusion coexists which contains CH_4 with some traces of ethane and graphite. Broad zoisite veins partly with interstitial albite, however, must have been formed later at decreasing pressures. The vein zoisites have similar homogeneous fluid inclusion composition in the system H_2O–NaCl–CH_4 like the eclogite-facies minerals, indicating homogeneous fluid composition during the eclogite-facies stage and during subsequent exhumation. Such homogeneous aqueous fluid composition can be best explained by aqueous fluid infiltration from an external source where dehydration of (OH)-bearing minerals takes place. Deserpentinization of the underlying oceanic mantle could be a realistic source for the liberated H_2O and CH_4 of the infiltrating fluid. This model gets supported by the fact that the serpentinized peridotites of Ecuador, geochemically defined as depleted MORB-mantle peridotites, have been subducted as well, reaching eclogite-facies conditions.

A comparison with eclogite-facies fluid composition from other eclogite complexes shows that low-salinity aqueous fluids with methane are rather the exception. Only in the Dabie-Sulu terrane of eastern China (Fu et al. 2003, J. Metam. Geol. 21: 561-578) also CH_4-rich fluid inclusions of pre- to syn-peak metamorphic origin have been identified. Fu et al (2003) related the formation of methane to the serpentinization of peridotites prior to or during subduction.