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Distribution of C-H-O fluids deduced from fluid inclusions from the Shimanto belt in the Muroto area,SW Japan

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Geofluids have compositions in C-H-O system, mainly composed of H2O, CO2 and CH4, and the compositional variation of fluids within the Earth's interior is of special importance for understanding the global carbon cycle. In this study, we characterized the C-H-O fluids in the ancient subduction zone, that were trapped in mineral veins as fluid inclusions within the accretionary complex, Shimanto belt, SW Japan. Although calcite-bearing veins commonly occur in the Shimanto belt, it is known that fluid inclusions were mainly composed of H2O and CH4; therefore it is unclear why calcite precipitated from the fluids in absence of CO2.

The Muroto Peninsula belongs to the Tertiary (Paleogene and Neogene system) Shimanto belt, and it is mainly composed of sandstones, mudstones and conglomerates with small amount of basalt. The ages of accretion become younger toward the south, and maximal temperature evaluated from the vitrinite reflectance increased from north(214C) to south(278C) in this area (DiTullio, 1993). Mineral veins were mainly composed of quartz, with small amount of calcite. We collected the mineral veins from the 9 outcrops along the coast, W1 to W5 in the western side, and E1 to E4 from the eastern side from Paleogene system. Lewis (2000) reported the fluid inclusions of CH4 and CO2 mixture at the locality W5, but the regional distribution of CO2 fluids is not clear.

The mole fraction of CH4 and CO2 gasses in the two-phase fluid inclusions in quartz veins and carbonic(one-phase) fluid inclusions in quartz and calcite were measured by the Laser Raman Spectroscopy (HoloLab, KAISER OPTICAL SYSTEMS Co.) with thin sections of veins. Homogenization temperatures of water-rich inclusions were measured by microthermometric techniques.

Two-phase fluid inclusions in the mineral veins in the Muroto area show the following features: (1) The gas phase of fluid inclusions are composed of pure CH4, or CO2-CH4 mixture, with various XCO2(=nCO2/nCO2+nCH4) values ranging from 0 to 0.8. Fluid inclusions with pure CH4 gas were found in the northern parts of the Muroto area (W1 - W4 and E1 - E3). (2) The average XCO2 values increased toward south, and the most southern points W5 and E4 shows XCO2 of 0.3˜0.8. (3) The XCO2 values are various within individual veins; fluids including CO2 (XCO2 $>$ 0) were located only close to vein walls, whereas gas phase of fluid inclusions composed only CH4 were located in the center of the vein. Even in a single quartz crystals in mineral vein, the XCO2 values are scattered, 0.18˜0.88.

One-phase carbonic fluid inclusions were composed of CH4. Calcite veins also contain this type of CH4 one-phase inclusion. Primary fluid inclusions were composed of CO2 and CH4 mixture as mentioned above, but gas phase of secondary inclusions were all composed of only CH4 in the whole Muroto area. The average homogenization temperature of W1 and W5, are 216 C at W1, and 226 C at W5, respectively.

The increase of CO2 gas with increasing temperature (W1 to W5) and occurrence of CO2-bearing inclusions near vein wall imply that CO2 fluids were generated by diagenetic processes of carboniferous materials in host rocks. We will discuss the timing and controlling factor to produce variation in C-H-O fluid inclusions both in regional and local scales.

Referances:DiTullio L., Laughland M. M., Byrne T., Thermal maturity and constraints on deformation from illite crystallinity and vitrinite reflectance in the shallow levels of an accretionary prism: Eocene-Oligocene Shimanto Belt, southwest Japan, Geological Society of America, special paper (1993), 273, 63-82

Lewis J. C., Byrne T. B., J.D.Pasteris, (2000) Early Tertiary fluid flow and pressure-temperature conditions in the Shimanto accretionary complex of south-west Japan: constraints from fluid inclusions, J. metamorphic Geol., 2000, 18, 319-333

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