

チリ・アタカマ断層系カレタコロソ断層中軸部の熱水変質 Hydrothermal alteration in the Caleta Coloso fault core zone of the Atacama Fault System, Chile

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The Atacama Fault System (AFS) is a trench-parallel large-scale structure developed within mesozoic rocks of the present-day Coastal Cordillera in northern Chile (Cembrano et al., 2005). Its well-documented left-lateral activity has been interpreted as the result of the SE-ward oblique subduction of the Aluk (Phoenix) oceanic plate between 190 and 110 Ma (e.g., Schuber and Gonzalez, 1999). Recent activity of the AFS has been documented mainly as extensional and interpreted as a reactivation of the system in response to mega-thrust earthquakes (e.g., Gonzalez et al., 2006).

The Caleta Coloso Fault of the AFS is represented as a N-S to NNW-SSE west-ward concave-shape sinistral strike-slip fault showing a left-lateral displacement of about 3 km and a subvertical dip (Cembrano et al., 2005). The fault cuts through crystalline rocks of predominantly granodioritic composition (Gonzalez and Niemeyer, 2005) and its fault core currently displays hydrothermally altered cataclastic rocks (Olivares, 2004).

Two types of hydrothermal alteration, chloritization and propylitization, can be observed in the Caleta Coloso fault core zone. The former is characterized by the replacement of hornblende and biotite by chlorite, epidote mineralization and compositional changes in rims of plagioclase to albite-rich ones, while the latter by the intense plagioclase albitization and mineralization of chlorite, epidote and calcite. XRF analyses and density measurements of the rock revealed that contents of Al and Ca decrease with increasing Si, while Na increases and K, Fe and Mg are stable. The data suggest that the changes in the bulk chemical composition during alterations were mostly due to the plagioclase albitization. Hence, it can be concluded that the propylitization occurred later than the chloritization.

Faulkner et al. (2006) reported that the density of microfractures shown as fluid inclusion planes (FIPs) in quartz of the host rocks of the Caleta Coloso fault increases towards the fault core. Fujita et al. (2010) also noted that the FIPs in the rocks close to the fault tend to orientate along the shear planes (Y and P planes and between T and X planes of the fault). Those evidences indicate that the microfractures were formed during faulting and healed by mineral precipitation from fluids passing through the fractures and that the fluids have been preserved as the fluid inclusions in FIPs (Fujita et al., 2010).

The fluid inclusions in the chloritized rocks show a wide range in homogenization temperatures from 140 to 270 C with variable salinities of 6 - 18 wt.% NaCl_{eq.}, while the temperatures of those in the propylitized rocks are low as 150 - 190 C (av. = 170 C) with high salinities as 12 - 18 wt.% (av. = 15 wt.%). Therefore, the fluid inclusions trapped in the both alterations stages are probably included in the chloritized rocks partly overprinted by the later propylitization. However, since the fluid inclusions of only low-homogenization temperatures with high salinities can be seen in the highly propylitized rocks, the most propylitization might completely alter the chloritized rocks with the intense albitization, resulting in removal of older fluid inclusions trapped during the earlier chloritization. Hence, it is supposed that the fluids of high-homogenization temperatures (ca. 250 C) and low salinities (ca. 9 wt.%) caused the chloritization, while those of low-homogenization temperatures (ca. 170 C) and high salinities (ca. 15 wt.%) did the propylitization.

Chemical compositions of chlorite coexisting with quartz indicate the chloritization temperature as around 330 C. A pressure at 330 C on an isochore for the 9 wt.% NaCl solution projected from the homogenization temperature of 250 C is about 1.1 kb, representing the chloritization pressure. Therefore, the propylitization temperature might be around 220 C if the propylitization occurred at the same depth with the chloritization.

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