延岡衝上断層のプレート沈み込み巨大分岐断層周辺における石英脈形成速度

The formation rate of quartz vein along seismogenic megasplay fault Nobeoka Thrust, southwestern Japan

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Precipitation of minerals has a role to fill the fractures, to form mineral veins, and to affect spatial and temporal change of the permeability of the Earth's crust. However, the change of permeability of crustal rocks has been discussed based on the geophysical properties, not on the geochemical reactions as dissolution-precipitation of minerals. Based on the ubiquitous observation of quartz veins and silica sinters, silica polymorphs are one of the most effective minerals on permeability change. Okamoto et al. (2012) and Saishu et al. (2012) revealed that precipitated silica minerals and precipitation rate depend on the concentrations of minor components in the fluid by the precipitation experiments at 430 ℃ and 30 MPa. Saishu et al. (2014) also revealed that the depth of the local minimum of quarts solubility where the quartz precipitation is dominant reaction correlates to that of the permeable-impermeable boundary at the Kakkonda geothermal field.
Fault zones including the damage zone and the fault core have a controlling influence on the crust's mechanical and fluid flow properties. In the Nankai subduction zone, southwestern Japan, the velocity structures indicate the contrast of the pore fluid pressure between hanging wall and footwall of the megasplay fault (Tsuji et al., 2014). At Nobeoka Thrust, a major fault bounding the northern and southern Shimanto belt of the Cretaceous-Tertiary accretionary complex in Kyushu, southwestern Japan, the microchemical features of syn-tectonic mineral veins along fault zones of the Nobeoka Thrust provide evidence of temporal fluctuations in redox state during repeated earthquake cycles within a seismogenic megasplay fault in an ancient subduction zone (Yamaguchi et al. 2011). The measurement of the strike, dip, width and length of the quartz veins that fill mode I cracks (extension quartz veins) around the fault zone of the Nobeoka Thrust indicated that the fluid driving pressure ratio P* at the time of fracture opening are 0.15-0.40 in the hanging wall and footwall, respectively (Otsubo et al., 2015). Otsubo et al. (2015) suggested two possible explanations for the observed spatial variations in P*: spatial variations in pore fluid pressure P_f are directly responsible for P* variations, or P* variations are controlled by differences in mechanical properties between the hanging wall and footwall.
In this study, the amount and rate of silica precipitation for the formation of the extension quartz veins of the Nobeoka Thrust were calculated to consider the relationship between the time frequency of fracture opening-closing and the precipitation of silica minerals. The initial pressure was lithostatic condition. Basically, the larger pressure drop enhances the larger amount of silica precipitation and the faster sealing of cracks. However, the precipitation rate depends not only PT conditions but also the host rock and fluid compositions etc. The time for the formation of quartz vein at Nobeoka Thurust was estimated in the various models, for example, that pressure drop from lithostatic to lithostatic, hydrostatic, and atmospheric pressure.
References: Okamoto et al. (2010) GCA., 74, 3692-3706; Otsubo et al., (2015) AGU abstract; Saishu et al. (2012), Am.Min., 97, 2060-2063; Saishu et al. (2014) Terra Nova, 26, 253-259; Tsuji et al. (2014) Earth Planet. Sci. Lett., 396, 165-178; Yamaguchi et al. (2011) Earth Planet. Sci. Lett.,

302, 369-377.

キーワード：延岡衝上断層、石英脈、析出反応速度
Keywords: Nobeoka Thurust, Quartz vein, Precipitation rate

