Salinity map of subduction-zones fluids recorded in fluid inclusions

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High-pressure experiments suggest that saline fluids can play a significant role in transfer of H_2O and elements from subducting oceanic plates to the mantle wedges (Keppler 1996 Nature, Kawamoto et al., 2014 EPS, Huang et al., 2019 Nature comm). In the natural rocks, we have observed fluid inclusions and reported saline fluids under various circumstances: mantle peridotites (Kawamoto et al., 2013 PNAS), jadeitites and jadeite-rich rocks (Fukuyama et al., 2017, JMPS, Kawamoto et al., 2018 Lithos), and high-pressure metamorphic rocks (Shinji et al., 2019 JMPS). Salinity of these fluid inclusions common ranges from 3-7 wt. % NaCl equivalent, which is similar to or a little greater than 3.5 wt. % NaCl equivalent of the present seawater. This may indicate seawater recycling via hydration and dehydration reactions of oceanic plates. In addition to these findings, we reported low-salinity saline fluids in listvenites (carbonates and quartz rocks) in Ethiopia (2 wt% NaCl equivalent, Kawamoto et al., Japanese Association of Mineralogical Sciences 2018 Fall meeting) and Oman (1 wt% NaCl equivalent, Kawamoto et al., JpGU 2019 meeting). Such fluid inclusions of the listvenites are characterized by their low-salinity of 1-2 wt% NaCl equivalent. This suggests us to interpret them as saline fluids diluted by on-going serpentinization in juvenile island arcs, where Cl is preferentially partitioned into serpentine minerals. This can result in the formation of low-salinity fluids as recorded in the fluid inclusions. Lower-salinity fluids dissolve less amounts of carbonate ions than higher-salinity fluids (Ellis, Am J Sci, 1963; Newton and Manning Am Mineral, 2002). Consequently carbonate minerals can precipitate from the low-salinity fluids, which forms carbonates-quartz rocks. If this is the case, subduction-zone fluids vary their salinity from deep to shallow locations and along with or without on-going serpentinization. In the Southwest Japan forearc, Arima-type springs show up to 5 wt% NaCl equivalent (Sano and Wakita, JGR 1985), while in Izu-Bonin-Mariana forearc, springs through serpentinite mud volcanoes are characterized by lower salinity than seawater (Mottl et al., GCA 2004). The latter low-salinity saline fluids can be observed in the fluid inclusions of carbonate minerals in the listvenites.

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