

Geochemical variations of the asthenosphere inferred from the geochemistry of petit-spot lavas in the NW Pacific plate

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The low seismic velocity and high electrical conductivity of the asthenosphere may be due to the presence of volatile materials (e.g. CO₂ and H₂O) (e.g. Gairrard et al., 2008; Hirschmann, 2010). Recently, the so-called “petit-spot volcanism” which is characterized by submarine eruptions that occur in oceanic plates in response to lithospheric flexures, has been proposed to result from melts directly ascending from the asthenosphere (Hirano et al., 2006; Sato et al., 2018). The lava samples (foiidite to trachybasalt) show high vesicularity despite the eruption occurring under high hydrostatic pressure at approximately 6000 meters below sea level (Sato et al., 2018). Here we discuss the volatile, bulk, and Sr-Nd isotopic compositions of quenched glass rinds of petit-spot lavas from the NW Pacific plate, supported by the JSPS Japanese-German Graduate Externship.

The glass has higher volatile contents (H₂O, CO₂, and halogens) than most MORBs and lacks chlorine alteration by seawater. Some samples are clearly oversaturated in CO₂ and H₂O at 60 MPa, which is the submarine hydrostatic pressure. The glass also shows negative anomalies of Zr, Hf and Ti, implying that there is a carbonatitic component in the mantle source. Moreover, Nd and Sr isotope ratios, and some geochemical trends with volatile elements indicate that the magma was derived from an EM1-like mantle component. Therefore, the compositions of the petit-spot lavas can possibly be explained by mixing of DMM and recycled EM1 material with carbonates. The degree of EM1 signature for each eruptive location gradually decreases toward the trench. We suggest that the variation of volatile compositions and Sr-Nd isotopic systematics of petit-spot magmas reflect their temporal and spatial transition in the asthenosphere along the NW Pacific plate track.

Keywords: petit-spot basalt, asthenosphere, volatile elements