

ボニナイト質メルト包有物から読む、沈み込み帯形成初期の流体の挙動 Volatile behaviors in an immature subduction zone inferred from boninitic melt inclusions

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Recent study suggests that boninites formed at the immature stage of subduction zone, whereas related arc tholeiites erupted 0-7 Ma after boninite formations (Ishizuka et al., 2011, EPSL, v306, p229-240). In order to constrain volatile behaviors of an immature subduction zone, we have analyzed major, volatile contents and sulfur isotopic ratios ($^{34}\text{S}/^{32}\text{S}$) of melt inclusions in Cr-spinel from fore-arc volcanic rocks in Bonin Islands and in Guam. All Cr-spinels are collected at volcanic sand beaches and purified for this study. Boninitic melt inclusions occur in Muko-jima, Chichi-jima and tholeiitic melt inclusions occur in Mukoo-jima and Guam. Cr-spinels in boninite are high in Cr# (mostly 80-90) and low in TiO₂ (< 0.1wt%), indicating highly depleted source. Whereas Cr-spinels in tholeiite vary in Cr# (45-80) and in TiO₂ (0.1-1 wt%). Compositions of melt inclusions fully cover compositional range of whole-rock. Some melt inclusions of boninites have MgO higher than 20 wt%, showing that they are very primitive magmas. H₂O and CO₂ contents of melt inclusions of Muko-jima boninite are high (up to 4 wt%) and low (< 50 ppm), respectively whereas those of Mukoo-jima tholeiite are lower (H₂O mostly ~1 wt%) and higher (CO₂ up to ~1000ppm). Except H₂O, volatiles of boninitic melt inclusions (F <20ppm; Cl <500ppm; S ~100ppm) are considerably lower than those in tholeiites (F up to 400ppm; Cl up to 3000ppm; S up to 3000ppm). High S content of tholeiitic melt inclusions may indicate high oxygen fugacity of the magmas. Sulfur isotope data of melt inclusions from boninites show the lightest value that reported from igneous rocks ($d^{34}\text{S}_{VCDT} = -5$ to -10), whereas those of tholeiites ($d^{34}\text{S}_{VCDT} = +2$ to $+5$) are comparable to reported arc tholeiite data. S source of tholeiite should be mixture of seawater-derived hydrothermal sulfites and mantle sulfide. Whereas S source of boninite can be seawater derived pyrite which precipitated in mantle, inorganically, because of reduced condition caused by water-mantle reaction. As source of boninite is hydrated hertzbergite, sulfur in the source before the hydration may be negligible. Therefore, all sulfur of boninite may be secondary origin. Assuming open system isotope fractionation, $d^{34}\text{S}_{VCDT}$ difference between seawater sulfate (20 permil) and pyrite (-5 to -10 permil) can be explained by pyrite precipitation at ~200°C, which is consistent temperature of serpentinization at subduction zone. Boninite may be formed by melting of this serpentinite at an immature stage. Further contaminations by fluid led higher oxygen fugacity at mantle wedge, forming arc tholeiites.

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