

Lithium and lead isotopes and trace element systematics of Quaternary basaltic volcanic rocks in Northeastern Japan

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Lithium isotope systematics together with lead isotope systematics and trace element compositions were applied to the Northeastern Japan arc basalts in order to understand material recycling between crust and mantle at subduction zones. Li/Zr and Pb/Nb ratios of the arc basalts decrease with depth of slab. This across arc profile and other trace element characteristics reveal the involvement of slab-derived fluid in the arc magma. In contrast, a positive anomaly in Li/Y and La/Sm ratios was found at around 180km depth to the Wadati-Benioff zone (WBZ). These convex across-arc profiles may reflect phase changes in the subducting slab at 180 km depth. In the lawsonite breakdown reaction (lawsonite + diopside + garnet¹ = garnet² + coesite + H₂O) (Schmidt and Poli, 1998), Y is strongly partitioned into garnet² and Li is strongly partitioned into H₂O. In addition, light rare earth elements (REE) could be released from the slab while heavy REE are partitioned into garnet² by lawsonite breakdown since lawsonite is a major REE carrier and concentrates almost all the LREE in blueschists (Tribuzio et al, 1996). As a result of this reaction, therefore, the Li/Y and La/Sm ratios of the slab derived fluid could be higher at around 180 km depth, causing the positive anomaly in these ratios. Sr, Nd and Pb isotope ratios show across arc variation in the Northeastern Japan arc basalts (Shibata and Nakamura, 1997) whereas the Li isotope ratios are largely variable at the volcanic front and do not show obvious across-arc variations ($\delta^7\text{Li} = +1.5$ to $+5.5$ ‰, $+1.9$ to $+3.5$ ‰ and $+2.2$ to $+3.2$ ‰ at 134 - 145 km, 174 - 180 km and 300 km of the depth of WBZ, respectively). Li-Pb isotope systematics suggest that sediment/alterated oceanic crust ratios in the fluid are variable and the proportion of a sediment component as a lower $\delta^7\text{Li}$ endmember is relatively larger at the volcanic front, resulting in this feature of the Li isotopic compositions.

References

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Thermal decomposition behaviours of humic acid by thermogravimetry

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In order to study thermal decomposition behaviours of humic substances in soil environments and in agricultural treatments, some standard humic acid powders (Wako, Aldrich) were heated from room temperature to 1000°C using a thermogravimetric analyzer (TG). The analyses were carried out using programmed heating rate of 10, 12.5, 15, 17.5, 20, and 25°Cmin⁻¹ in N₂ atmosphere. The weight of humic substances decreased in about 40% during the TG analysis. The first derivatives of thermogravimetric mass loss curves (DTG curves) were calculated to identify the details of TG loss. Five peaks were found in the DTG curves at 64~69°C (stage 1), 135~145°C (stage 2), 245~255°C (stage 3), 410~430°C (stage 4) and 650~670°C (stage 5). The activation energies calculated were 71 (stage 1), 95 (stage 2), 137 (stage 3) and 253 (stage 5) kJmol⁻¹ respectively, using the kinetic approximation method by Braun and Burnham (1987), except for the stage 4. The obtained DTG curves and activation energies were compared with those for biomasses (García-Pérez *et al.*, 2001), which were raw materials of humic substances. The first process was caused by dehydration. The second process, with a weight loss of less than 1%, was possibly due to OH release or decomposition of sugar. The main weight loss occurred in the later stages. The third stage might correspond to the decomposition of materials such as cellulose. The fourth stage might be due to the transition of lignin. The fifth stage, having the highest activation energy, might be attributed to the transformation of aromatic materials. These results, together with infrared spectroscopy on heated products, can be used to understand complex decomposition processes of humic substances.

References

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