

Tectonically controlled across-arc variation in phenocryst assemblages

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The K-level in volcanic rocks is lowest at the volcanic front and highest at the back-arc side. The origin of the across - arc variations have been examined by many researchers, and Kimura and co-authors concluded that seismic observations are consistent with the results of their model derived from the geochemical mass-balance calculation package called the Arc Basalt Simulator. Quaternary calc-alkaline andesites from NE Japan arc have shown a clear lateral variation in phenocryst assemblages (Sakuyama, 1977; Nakagawa et al., 1986). Volcanoes that are composed of rocks without hornblende and biotite phenocrysts are dominantly distributed in the frontal volcanic zone. Those with hornblende and no biotite phenocrysts occur mainly in the back-arc side of the volcanic front, and those with biotite and hornblende phenocrysts mostly appear in the area furthest from the volcanic front. The most primitive frontal low-K tholeiitic basalts, however, have a higher water content than the frontal calc-alkaline andesites, that is same level to the rear-arc primitive basalts (Kuritani et al., 2013, 2014). The estimated lower H₂O content in the frontal calc-alkaline andesites and higher H₂O content in the frontal primitive basalts same with rear-arc basalts suggests that the mafic end-member of frontal calc-alkaline magmas degassed before forming andesites by any process (Yoshida et al., 2014). Under strong compressional stress conditions, the excess volatiles (Miyagi et al., 2012) which were degassed from the deep-seated mafic magma reservoirs could have risen directly upwards, or could have escaped to the trench side along thrust sheets, forming seismically active focused deformation zones (Okada et al., 2010). These tectonic degassing processes could have been more effective at the volcanic front to the forearc region than in the rear-arc side, owing to the strong shortening deformation associated with nonlinear viscous flow (Shibazaki et al., 2008), and resulting the observed lateral variation in phenocryst assemblages of the Quaternary volcanic rocks in NE Japan arc.