Geophysical Research Abstracts
Vol. 19, EGU2017-17208-1, 2017
EGU General Assembly 2017

Numerical modeling the genetic mechanism of Cenozoic intraplate Volcanoes in Northeastern China

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Changbaishan Volcano located about 1400 km west of Japan Trench is an intra continental volcano which having different origin from island arc volcanoes. A number of different mechanisms have been proposed to interpret the origin of intraplate volcanoes, such as deep mantle plumes, back-arc extension and decompressional partial melting, asthenosphere upwelling and decompressional melting, and deep stagnant slab dehydration and partial melting. The recent geophysical research reveals that the slow seismic velocity anomaly extends continuously just below 660 km depth to surface beneath Changbaishan by seismic images and three-dimensional waveform modelling [Tang et al., 2014]. The subduction-induced upwelling occurs within a gap in the stagnant subducted Pacific Plate and produces decompressional melting.

Water in deep Earth can reduce viscosity and lower melting temperature and seismic velocity and has effects on many other physical properties of mantle materials. The water-storage capacity of wadsleyite and ringwoodite, which are the main phase in the mantle transition zone, is much greater than that of upper mantle and lower mantle. Geophysical evidences have shown that water content in the mantle transition zone is exactly greater than that of upper mantle and lower mantle [Karato, 2011]. Subducted slab could make mantle transition zone with high water content upward or downward across main phase change surface to release water, and lead to partial melting. We infer that the partial melting mantle and subducted slab materials propagate upwards and form the Cenozoic intraplate Volcanoes in Northeastern China.

We use the open source code ASPECT [Kronbichler et al., 2012] to simulate the formation and migration of magma contributing to Changbaishan Volcano. We find that the water entrained by subducted slab from surface has only small proportion comparing to water content of mantle transition zone. Our model provide insights into dehydration melting induced by water transport out of the mantle transition zone associated with dynamic interactions between the subducted slab and surrounding mantle.

References

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