Evidence for lithosphere deformation of the Nuomin River volcano in northeast China

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Intraplate volcanoes are different from interplate volcanoes. Their origins have no direct causal connection with plate boundary condition or plate movement velocity, which have always been controversial. Northeast China contains several Cenozoic intraplate volcanoes such as the Changbaishan volcano, Wudalianchi volcano, Aershan volcano, and Nuomin River volcano, making it a great place to study the mechanism of intraplate volcanism. Among those volcanoes, the Nuomin River volcanoe's causative mechanism is poorly understood due to a lack of detailed constraints on the upper mantle structure beneath this region. Previous studies show that there are obvious low-velocity anomalies in the upper mantle of Changbai Mountain and the Aershan volcano and extend all the way to the top of the mantle transition zone, whereas the low-velocity anomalies of the Nomin River volcano and the Wudalianchi volcano are much shallower. Similar to the adjacent Wudalianchi volcano, the Nomin River volcanic rock is potassic; however, it is quite different from the Aershan volcano which is sodic. The differences in chemical composition and physical properties of these volcanoes suggest that they may have undergone different asthenosphere and lithosphere deformation. Therefore, the deep structure study of the Nomin River volcano will provide necessary evidence for understanding the volcanic activity of the Cenozoic in northeastern China.

Seismic anisotropy determined by splitting of shear waves is one of the most effective conventional methods for studying mantle flow and lithospheric deformation. A total of 82 pairs of shear wave splitting measurements and 219 null measurements were obtained at 40 temporary seismic stations. Delay times vary from 0.4 s to 1.4 s with an average value of 0.78±0.21 s; whereas fast directions trend N77°W to N18°E with a mean value of N6.9°W±9.87° at most of stations. A fossil anisotropy within the lithosphere is believed to be the main origin of anisotropy since the fast directions are in line with an extensional orientation of the late Mesozoic lithosphere in this area. Solely null measurements were measured at 19 stations, indicating lithospheric thermal erosion by hot mantle upwelling.

References

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