A study on electric resistivity structure beneath the Tianchi volcanic area of Changbaishan Mountain,NE China, and dynamic process

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The Tianchi volcano, one of the most active Quaternary volcanoes in China, locates in the east part of Jilin province, NE China. It belongs to tensile stress zone of the Pacific back-arc. In recent years, the observations indicate that Tianchi volcano may have risk of eruption after its last activity in 16th century. In order to investigate the volcano's potential for future eruption and to understand the dynamic process of the volcano, 61 MT measurements and 4 Network-MT measurements have been carried out around the Tianchi Volcano and Jilin province, NE China, respectively.

Highly reliable MT responses and induction arrows have been obtained. Bahr's impedance tensor decomposition was then applied to decompose MT responses for eliminating distortion. The electrical conductivity structure of the crust and upper mantle beneath the Tianchi volcanic region has been investigated by using two-dimensional (2-D) inversion and three-dimensional (3-D) forward modeling. The results show that there exists a low resistivity body at about the depth of 10-15 km beneath the Tianchi and its northern and eastern flank with thickness 20-30 km. This deep crustal low resistivity body may be reflecting the presence of a magma chamber. The other investigation, such as geological, seismic and geo-chemical (Liu, 1997; Zhang, 2001;Shangguan, 1998), considered also that there exists a magma chamber at Tianchi volcanic area in the Changbaishan Mountain.

Very long period (up to the periods of 105~106 S) MT and the GDS responses were analyzed to explore the structure deep in the mantle. 1-D inversion with minimum and smooth structure constrains was applied. The result suggests that there are possible electric resistivity interfaces at the depth range of 100-150 km and 550-630 km corresponding to the bottom of lithosphere and mantle transition zone, respectively. These features are comparable to those by seismic tomography (Fukao, 1992; 2001) and petrological investigation (Fan, 2000).

According to Peacock(1990), subducting slab can carry six times more water into the mantle than the total amount of water delivered to the surface by arc volcanism. The water, carried into the mantle, is stored in hydrous minerals, silicate melts, or as free fluid. When the slab subducted to 410-660 km, the mantle transition resists the slab from going continuously downward. It changed into horizontal movement which is called the stagnant slab (Fukao, 2001). The Changbaishan volcanoes and Huichun deep earthquakes zone (the epicenter is 600 km) are located above the corner where the downgoing slab turns to be stagnant. In this situation, dehydration (Thompson, 1992) may occur by the phase transition because of the special stress state at this place. The 'water' may be stored in minerals or in melts, which migrate up to the depth of about 100 km. Then, it is resisted by the lithosphere and accumulates here so that a large magma chamber may be formed in the mantle. The magma overflows through a weak zone such as rift belts or large active faults. Thus basaltic volcanoes in this region can be accompanied by a large magma chamber in the mantle as well as a crustal chamber (Tianchi volcanic region) .

In conclusion, MT and Network-MT studies in NE China revealed low resistivity bodies in the crust and the upper mantle beneath the Tianchi volcanic area of the Changbaishan Mountain, which indicate the possible presence of two different magma chambers. These magma chambers are situated above the corner between the downgoing and stagnant slab. This continental magmatism may be caused by dehydration of hydrous minerals and upwelling of fluid from deep mantle.