STUDY ON TRANSMISSION MECHANISM OF THERMAL INFRARED REMOTE SENSING FOR ABRUPT GEOTHERMAL ANOMALY IN VOLCANIC REGION

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ABSTRACT: Experiment researches have proven that there is an obvious phenomenon of abrupt geothermal anomaly in volcanic region in the forewarning period of volcano eruption, which is closely related to the geological structure, the cause, the scale and the type of volcano etc. On the other hand, this kind of geothermal anomaly is an important sign to monitor volcano activity by thermal infrared remote sensing techniques. This paper discusses the feature of abrupt geothermal anomaly, the transmission mechanism of geothermal anomaly and the radiation transmission mechanism of heat field of terrene in volcanic region. By analyzing mechanism of terrene temperature rising by way of conduction and convection of heat, we have presented the transmission equation of atmosphere for thermal infrared radiation based on the effective radiation of objects. The related problems of noise interference in the processes of transmission for thermal infrared radiation will be discussed in the later paper.

KEY WORDS: volcano, abrupt geothermal anomaly, thermal infrared remote sensing

Geothermal anomaly is a phenomenon that underground temperature and geothermal gradient increases much more in the area than its surroundings (Xia, 1979). Abrupt geothermal anomaly means that underground temperature on some spots as well as the affected temperature of surrounding area abruptly increases in a short time. Its geophysics properties represent time and space feature of current underground magma activity or crush movement intensity in the area, which contains much information for geology, geophysics and geo-dynamics. So the above information is very important physical values to monitor and forecast temporary volcanic activity, the expression formula is:

$$\Delta T > \omega$$

where $\Delta T$ is an average temperature difference of anomalous and normal area, $\omega$ is a threshold value of volcanic activity intensity. The above formula means if the average temperature difference is as high as to a critical value, a certain type of volcano will be probably erupted in some extents. The apparent form of abrupt geothermal anomaly in volcanic region appears as much increase of the geothermal current. The geothermal current (Chen et al., 1994) is represented as unit scattered quantity of heat per unit time from internal to the surface of the earth, which is a comprehensive parameter, having a certain regional representation. It not only reflects deep or shadow thermal statues, but also is of important significance to study new structure motion, hydro-geological

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condition as well as geothermal anomalous cause of formation in anomalous region's surroundings. In the forewarning period of volcano, the geothermal current in anomalous region is higher than in normal region because of the abrupt geothermal anomaly. After the geothermal current reaches the surface of earth, it will radiate to the sky in the form of radiation transmission, through atmosphere layer, accepted by thermal infrared sensor. So accepted values for temperature difference, combined with other geophysics parameters such as earthquake, crush deformation, geomagnetism, crush stress etc., perform real monitoring for volcano activity. This is a theoretic base of monitoring volcano activity by thermal infrared remote sensing techniques.

As studied by Rybach and Muffler, geothermal feature varies as the times, scale and type of volcanic activity. For this reason, when we study remote sensing monitoring for abrupt geothermal anomaly, we must be aware of different types of volcanic abrupt geothermal features. Next, different volcanic construction, geology structure, volcano surrounding rock and soil layers have its own thermal anomaly. Knowing geothermal transmission mechanism under various conditions is necessary to accurately monitor and forecast volcanic activity. Finally, in the process of geothermal field transmission towards atmosphere, the geothermal field will be interfered by various factors. Deeply studying thermal radiation transmission and various interfere noises in anomalous region is also a key content of thermal infrared remote sensing monitoring. This paper discusses the thermal infrared remote sensing mechanism of the thermal transmission and radiation of abrupt geothermal anomaly.

I FEATURES OF ABRUPT GEOTHERMAL ANOMALY IN VOLCANIC REGION

According to the slab theory, volcano emanation is a form of strong release of substance and energy inside the earth. When cold oceanic slabs go down to one side of island arc from oceanic trench, during the initial period, volcanic activity could not be caused in virtue of low temperature. Crush materials melt under the action of various stresses at a specified distance and depth of the slabs (You et al., 1998). Thus, melting substances will erupt from rock faults or rupture belts under the action of high pressure (Song et al., 1990; Jin et al., 1994). During the development of volcano, abrupt geothermal anomaly definitely occurs at repeated times, however, pocket of magma detained at shadow crush is only the ideal hot spot source of geothermal anomaly in volcanic region. Deep melting magma in the course of moving up by high pressure excites pocket of magma. Therefore, the existed anomalous subterranean heat is aroused into abrupt geothermal anomaly. Different types of volcanoes have different geothermal features. Studying different types of geothermal features and intensity of volcano activity is one of thermal infrared remote sensing monitoring and forecasting.

1.1 Volcanic Position at Global Structure Determines Geothermal Global Layout

Slab boundaries and its surrounding regions are one of the strongest areas in the global structure activity, which are able to present the high heat flow anomaly. This kind of anomaly mostly produces intense water heat activities and geological structure conditions and heat background necessary to high temperature water heat system. This also is the biggest temperature difference area between anomalous and normal region, in which formation and expansion of high temperature geothermal belts are closely linked with the occurrence, development and evolution of lithosphere. Belt's construction moves violently, age of heat events is less, and ground heat flow values are higher. High temperature belts are generally located near the boundary of every big slab. Inversely, in vast areas far away the boundary of slabs the construction moves weakly, and becomes relatively stable slabs. Heat background tends to the low side, and coefficients of water heat also decrease. In general, there is a low and middle temperature belt to be formed, whose distributions have something to