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Thermal infrared anomalies characteristic of magnitudes>8.0 earthquakes in CHILE

Dongmei Song (1,2), Liang Xiang (1,3), Xinjian Shan (4), Jingyuan Yin (5), Jianyong Cui (1,2)

(1) School of Geosciences, China University of Petroleum, Qingdao, China, (2) Laboratory for Marine Mineral Resources, Qingdao National Laboratory for Marine Science and Technology, Qingdao, China, (3) Graduate School, China University of Petroleum, Qingdao, China, (4) Institute of Geology,China Earthquake Administration,Beijing, China, (5) Shanghai Earthquake Administration,Shanghai,China

Chile and its surrounding areas are located in the subduction zone between Nazca Plate and South America Plate, and this region is one of the frequent earthquake regions globally. Especially in recent 10 years, more than 100 earthquakes above Ms6.0 have occurred in this region, causing serious destruction.
The research on tectonic activities with thermal infrared information is a new exploration, where how to remove the non-tectonic factor information and extract reliable thermal information related to tectonic activity from thermal infrared information obtained by satellite remote sensing data is one of the key issues when using thermal infrared information to characterize seismic thermal anomaly phenomenon. In this study, we proposed a novel algorithm to extract the seismic thermal infrared anomalies based on MODIS surface temperature data, taking two seismic events with magnitude > 8.0 for example in Chile. The surface thermal infrared radiation are affected not only by tectonic activities but also disturbed by many non-tectonic factors such as atmosphere circulation, solar radiation, vegetation coverage and human activities and so on. Therefore, not all of surface infrared anomalies are related with tectonic activities or earthquake. While various influence factors present different time cycles and spatial interaction scales, which provides us a possibility for signal separation. In the new method, first, eliminating the impact of some atectonic activities such as terrain and stable annual circle background component of solar radiation on the thermal anomaly extraction process by using wavelet multi-scale analysis technique. Second, eliminating the influence of atmospheric circulation in the large spatial scale and the influence of human activities in the small spatial scale by 2D wavelet analysis. Finally, we obtained the tectonic thermal anomaly which must satisfy simultaneously the following two rules. 1) the time of continous duration of the thermal infrared anomaly is longer than 2 months. 2) the variation amplitude of thermal infrared anomaly is more than 0.6 degree centigrade.
From the thermal response chart of the 2 seismic events, it can be seen that there was significant anomalies along belt in the Andes near the epicenter, beginning from 2 months prior to the earthquake, agree well with the corresponding subduction zone, in which the two earthquakes occured. The thermal anomaly gradually disappeared with the reduction of aftershocks. It is worthy note that these two earthquake demonstrate different thermal anomaly phenomenon. In the earthquake case in 2010, we observed the temperature decrease belt prior to the earthquake events. While in 2014 events, we have seen two almost parallel belts, presenting temperature decrease and temperature rise respectively. To conclusion, a new method allow us to see the significant thermal infrared anomalies before the earthquake in Chile.

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