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An unidentified geophysical event recorded with L&R-ET gravity meter at Zhongshan Station, Antarctica

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Abstract An unidentified geophysical event is first reported in this paper. It was recorded with Lacoste & Romberg earth tide gravity meter (ET-21) at Chinese Antarctic Zhongshan Station.

Key words Antarctica, Zhongshan Station, earth tide gravity meter, geophysical event, the earth's core, the matter's disturbance.

Many geophysicists thought that the earth's internal activities indicated by using gravimetric observation on the earth's surface are unstable. The reason why they did so is still unknown. So whenever an unexpected abnormal event occurs, it usually greatly attracts scientists' interest. A theoretic leap resulted from the study of an abnormal event such as the earth's free nutation was discovered in 1891 by Chandler from his investigation of the latitude's change. Besides Benioff discovered the earth's free oscillation from the earthquake records of Kamchatka Peninsula on Nov. 4, 1952.

From 22∶00UT Jan. 25 to 10∶00UT Jan. 28, 1997, a 60 h stable distrurbance was detected by the Lacoste & Romberg Earth Tide 21 Gravity meter which was installed at Zhongshan Station, Antarctica by the Institute of Geodesy and geophysics, Chinese Academy of Sciences. The disturbance's maximum amplitude is ± 3 μgal. After denying the possibility of instrument malfunction or external interference, the author thought it to be an integral, typical but unidentified "geophysical event".

The "event" may be divided into three stages: start, outburst and recovery. It started from 22∶00UT of Jan. 25. At the start stage, the recording curve line became thicker and thicker, i.e., the signal's amplitude was gradually increasing. After 18 h from the start, the amplitude reached to its maximum and continued stably for about 17 h. This is the outburst stage. From 9∶00UT of Jan. 27, the disturbance decreased. The state restored completely at 10∶00UT of Jan. 28. The event totally lasted about 60 h.

Generally, a gravity meter can record two kinds of information: (1) the earth's surface quakes; (2) a matter disturbance. The former gives us some geometric information caused by gravimeter's slightly shake, and the letter shows the physical information caused by the change of gravity. However, they often happened simultaneously in the same event. But in some cases we need to distinguish whichever is the master.

In Antarctica, some quakes resulting from earthquakes or avalanches can be recorded every week. But the "event" recorded by ET-21 was greatly different from these quakes. Firstly, the "event" needed tens of hours to reach its maximum so the sign of its occurrence can be found. The surface quakes burst out abruptly. Secondly, the "event" outburst stage lasted tens of hours, and its amplitude was stable. For the surface quakes, it only lasted tens of minutes, and its amplitude was unstable. Lastly, the "event" recovery stage lasted tens of hours, and its amplitude vanished slowly. For the surface quakes, the amplitude vanished abruptly and the recovery stage only several hours.

Since the propagation velocity of earthquake wave in the earth is 6~8 km/s, it spreads the whole earth at no more than half an hour. So the event, of which the start stage lasted tens of hours, can not be caused by earthquakes or avalabches, i.e., its gravity effect mainly resulted from the matter's disturbance rather than the surface quakes, which are related to earthquakes or avalanches.

If the matter's disturbance resulted in the "event", where did it come from? The earth's curst, which is solid, cannot be movable. The viscosity of the earth's mantle is very great, so the velocity of mantle flow is very slow. The temporal scale of the disturbance caused by mantle flow should be the order of months or years instead of days. So the event came from neither the crust not the mantle.

It is reasonable to attribute the event to the disturbance of the matter in the earth's core. Firstly, the earth's core is a state of liquid. The temporal scale of its disturbance can be within several days. Secondly the polar region is the nearest to the core. So the possibility for a gravimeter to detect the core's disturbance is the greatest. Just like the terms of the earth's free nutation and the earth's free oscillation, we temporarily named the event "the earth's core disturbance". Neverthless, it still needs to be further proved.

After Jan. 25, the earth's core disturbance also occurres on Feb. 9, 19, 23, March 29, and May 8, 24 at Zhongshan Station. At present the earth's core disturbance is only an assumption. If the earth's core disturbance occurred in group, how long is its outburst period? What is its origin? It is a strange phenomenon that in the period of the outburst of the disturbance group the earthquakes occurred in Tibet, Xinjiang, Iran, India and New Zealand. Whether the disturbance group is really related to the earthquake group is still in question. So further studies are needed to testify these assumptions.

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