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Thermoluminescence and ESR study of shocked albite

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A semi-circular topographical feature (approximately 900 meters in diameter) is located in the eastern side of Mt. Oikeyama on Shirabiso Highland, which lies in the southern part of the Akaishi Mountains, Nagano Prefecture in Japan. Planar microdeformations of the quartz were found in sandstone from this area. These planar microdeformations might be so-called planar deformation features (PDFs) that were formed by the impact more than 10GPa, suggesting that this structure has been a crater formed by hypervelocity impact event.

Thermoluminescence (TL) of three samples, sandstone collected from outside of the crater, sandstone experimentally shocked by railgun (abbreviated to railgun sandstone), and sandstone collected inside of the crater (abbreviated to metamorphic sandstone) had been measured to investigate evidence of impact shock metamorphism. A new, relatively large, peak had appeared at 350 ^{o}C in induced TL glow curve of the railgun sandstone, comparing with that of the sandstone collected from the outside of the impact crater. There is a slight bulge TL peak at 350 ^{o}C even in the metamorphic sandstone. TL spectral measurements had been also carried out for the three sandstones by a monochromator attached a 2D TL readout system. The new TL peak at 350 ^{o}C had appeared at 380 nm for the railgun sandstone and the metamorphic sandstone, different from 420 nm emission at low temperature. TL images had been measured with the 2D TL readout system to identify mineral responsible for the TL at 350 ^{o}C. The mineral responsible for the peak at 350 ^{o}C was albite, whereas potassium-rich feldspar was responsible for the TL at 150 ^{o}C.

In the present study, we ascertain whether this new TL peak will be really produced by shock in albite or not. The albite from Minas Gerais, Brazil was used as sample, and two stage light gas gun in JAXA was used for shock recovery experiments. Velocity of projectile was set to be 3.6km/sec, and estimated shock pressure was 50 - 80 GPa. In results, shocked albite had a different induced TL glow curve from that of unshocked albite. Induced TL glow curve of unshocked albite has peaks at 130 and 230 ^{o}C. On the other hand, that of shocked albite has peaks at 130, 230 and 300oC. It seems that the TL peak at 300 ^{o}C was produced or made sensitive by shock. The unshocked albite from Minas Gerais had two spectral peaks at 380 and 540 nm in TL spectral measurement. However, shocked albite changed to have a broad peak at 500 nm. It seems that the two spectral peaks at 380 and 540 nm decreased their sensitivities and produced a new emission center at 500 nm. In ESR spectrum measurement, the unshocked albite had a signal of g=2.0003. However shocked albite had a different signal of g=2.0041, and the signal of g=2.0003 disappeared.

Above data imply that heavy shock pressure of 50-80GPa make the albite change TL glow curve, TL spectra and ESR signals. TL Emission at 500 nm in feldspar is attributed to a defect of O^{-}-Si...X^{+}, and there is a probability that the ESR signal of g=2.0041 in shocked albite is related to Na collodion. Defects responsible to these TL emission and ESR signal are in further investigation.

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