Measurement of the glass transition temperature of sedimentary rocks by means of thermogravimeter-differential thermal analyzer

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1. Introduction

During an earthquake, when the rocks on the fault surface melt, the friction coefficient decreases and the amount of slip increases. The process of friction coefficient change is measured in experiments in which two cylindrical or cylindrical samples are rotated while being pressed against each other to cause shear friction (e.g. Hung et al, 2019). In these experiments, the melting point of the rock is estimated from the mineral composition. However, the temperature measured by thermography is lower than the melting point estimated from the mineral composition (Hung et al, 2019). Based on these facts, we attempted to measure the melting temperature of rocks by using thermodynamic measurement methods.

2. sample and method

In this study, samples were taken from the Nishizaki Formation in the Boso Peninsula. The rock samples were ground into powder samples using an iron mortar and an iron pestle. Each powder sample was subjected to XRD analysis to determine the composition of the rock. Melting experiments in an electric furnace to confirm that the melting occurs within the temperature range of the analyzers. TG-DTA measurements to determine the melting points. For melting in the electric furnace, about 100 mg of the powdered sample was placed in an alumina combustion boat and heated to 1500 ˚C in the electric furnace. TG-DTA measurements were performed using the TG8120. TG-DTA is a thermal analysis method in which a powdered sample and a reference material, whose thermal properties hardly change in the temperature range to be measured, are heated at a constant rate in an electric furnace, and the Thermo Gravimetry (TG) and differential thermal analysis the temperature difference between the sample and the standard (DTA) of the sample and the reference material are measured. The TG curve, which represents the temperature change of TG, and the DTA curve, which represents the temperature change of DTA, are detected. The changes in the TG curve and DTA curve are measured to determine the thermal change. About 15 mg of the powdered sample was weighed and placed in a sample pan made of -α-Al_2O_3 for the measurement. A standard sample of about 15 mg of Al_2O_3 was used. The measurement program was as follows: heating up to 800˚C at 20 K/min, cooling down to 50˚C, heating up to 1300˚C at 10 K/min, cooling down to 50˚C, and heating up to 1300˚C at 10 K/min.

3. result and consideration

The minerals measured by XRD analysis are mainly quartz, including albite, calcite, and halloysite. A glassy luster was observed in the sample heated in the electric furnace, indicating that it may have been melted. As a result of TG-DTA measurement, endothermic peaks were observed at around 1130˚C and 1270˚C in the DTA curve. The sample from which TG-DTA were collected from the container and subjected to XRD analysis. The peaks of quartz, albite, and calcite disappeared, and broad peaks were confirmed. The observation of the sample in the electric furnace, the peaks measured by TG-DTA, and the changes in the peaks of the XRD spectrum, it is considered that the sample melted and formed a glassy material. he temperature of melting point is considered to be between 1100˚C and 1300˚C.

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