OSL dating of shallow marine sediments

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1. Introduction

Marine terrace stratigraphy in Japan is compiled recently by Atlas of Quaternary Marine Terraces in the Japanese (ed. Koike and Machida, 2001). However, there is a little geological age information of higher marine terraces that were occurred before the marine oxygen isotope stage (MIS) 7. Therefore, we research dating of marine terrace deposit by the Optically Stimulated Luminescence (OSL) method. In this presentation, we will report OSL dating results of shallow marine deposits, which compose marine terrace deposits, and discuss the relationship between OSL ages and sedimentary facies.

2. Geological setting of dating samples

The sampling points located in Shiroku, Aso Town, Ibadragi Prefecture. The marine terrace of the altitude of 34-38m is widely distributed around here. Koike and Machida (2001) reported that this terrace was formed during MIS5e-5c.

The outcrop at the sampling point is about 12m in height, and its geological sequence consists of 1.5m-thick red-brown aeolian deposit and 11m-thick well-sorting laminated sand. We divided this sand sequence into five sedimentary faceis: coastal swamp (0.6m), backshore (1.4m), foreshore (3m), foreshore-shoreface (1.5m), shoreface (3m+), in descending order.

3. Sampling method and sample preparation

A sample was picked up by driving a polyvinyl chloride pipe with hammer hitting. A pipe is 5cm in diameter and about 30cm in length.

Quartz grains in the size ranges of 0.075-0.125mm were extracted from the deposit under 40-lux orange light (540-670nm) in the laboratory. We have done the illumination test, and showed that this illumination condition isn't effective to OSL. The separation procedure involved digestion in 36% HCL acid for 48 hours, digestion in 20% NaOH solution for 24 hours, dry sieving, heavy-liquid (SPT) flotation to the 2.63-2.68 g cm-3 fraction, and finally etching in 23% HF acid for 2 hours.

4. Dating Method

To estimate equivalent values, the multiple-aliquot additive-dose dating was performed using RISO TL/OSL System Model TL-DA-15. The samples were preheated for 10s at 280C. After 30 seconds of IR exposure, we measured 270-380nm luminescence for 1s under 125C with 420-550nm light stimulation. OSL intensities were normalized by weight.

We considered the contribution of beta-ray and gamma-ray dose calculated from the concentrations of radioactive elements using the conversion factors of Adamiec and Aitken (1998) and cosmic ray dose rates after Prescott and Hutton (1994). Attenuation of radiation dose by ground water (Henning and Grun, 1983) and grain size effects (Fleming, 1979) were considered. Furthermore, the evaluation of the water contents is important here to obtain the correct dose rate. Ages obtained by considering the water-saturated conditions show the maximum age, and natural conditions show the minimum age, after Tanaka et al. (1997).

5. Results and discussion

OSL ages in the foreshore and foreshore-shoreface zones are about 100ka, showing good agreement with the estimated age of the terrace formation. These have large errors, but at least these don't belong to MIS7.

Two OSL ages in the backshore zone are younger than the estimated age of the terrace formation. OSL ages in the shoreface zone are older. We could interpret that OSL ages in the backshore zone indicate deposition after the terrace formation, and that complete optical bleaching of quartz grains doesn't occur during sedimentation of the shoreface zone.

6. Conclusion

There is a great meaning in our dating results in the point that reflect the sedimentary process. Our results indicate complete optical bleaching during marine terrace formation. Therefore, the OSL dating method can date marine terrace deposits in the precision that distinguish marine oxygen isotope stages. Furthermore, we can do more reliable correlation of middle/higher marine terraces using both the OSL dating and terrace stratigraphy.