Optically Stimulated Luminescence Dating and Its protocols Relevant to Geological Application

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1. Introduction

Luminescence is observed when the electrons released from traps by heating or optical stimulation of crystal recombine with lattice defects which act as luminescence center - thermoluminescence (TL) and optically stimulated luminescence (OSL), respectively.

The OSL dating technique was introduced by Huntley et al. (1985), who showed that luminescence induced by optical stimulation from quartz grains could be used for sediments dating. That is, the luminescence would be bleached out of the crystals by sunlight as the sediment is deposited. After exclusion of light by subsequent deposits the latent luminescence would build up due to the influence of the natural radioactivity round about. In the laboratory, controlled measurement of the OSL intensity should eventually provide a measure of the time since deposition. Interpretation of the intensity as an age depends on the dose rate from the natural radioactivity at the site. The OSL ages can be obtained from equivalent dose value of quartz grains divided by dose rate of sediments from which quartz grains are derived.

When determining the age of a sample using the OSL, evaluation of the equivalent dose is an essential part of the process. Although several methods have been discussed so far, the single aliquot additive protocol and the single aliquot regeneration protocol are generally employed for their accuracy and reproducibility.

In this study, we report on preliminary results on the equivalent dose value obtained using the two protocols mentioned above by blue light stimulation of quartz from marine terrace sediments

2 Experiments and Results

Samples were taken systematically from marine terrace deposits in Southeastern coastal area of Korean peninsula. We used stainless-steel pipe and dark paper for the samples not to be exposed to sunlight which will cause the natural signal to be bleached. Sampling of sediments for water content measurement was carried out separately. In laboratory's dark room, only the materials in the middle part of the stainless-steel pipe were processed for luminescence analysis. Quartz grains 90-125㎛ in size were separated by wet sieving and chemical treatments (hydrochloric acid and hydrofluoric acid). The purity of the quartz was tested by IR-stimulation with some randomly selected samples. Any such signal from IR stimulation indicates the presence of feldspar, the most probable contaminants.

The resulting materials in both ends of the pipe, which may have been exposed to sunlight during wrapping in the field, are used for dose-rate measurements.

The single aliquot additive and single aliquot regeneration protocols were applied to obtain the equivalent dose values using the Risø automation system installed in Korea Basic Science Institute, Daejeon, South Korea. We analyzed 7 samples which were stratigraphically collected from Oryu (3), Kwan-Seong (3) and Suryeom (1) terrace.

Though we didn't get dose rates of these samples for obtaining OSL ages yet, coincident equivalent dose values were observed from the two protocols mentioned above (Table 1).

Table 1. Equivalent dose values (D_E) determined using single aliquot regeneration protocol (SAR) and single aliquot additive-dose (SAA) method

Sample	Single Aliquot Regeneration protocol (Gy)		Single Aliquot Additive-dose (Gy)	
	D_E	n[1]	D_E	n[1]
0012OR-1	185 ± 24	10	-	-
0012OR-3	157 ± 19	7	-	-
0012OR-5	177 ± 20	10	-	-
0011KS-1	204 ± 18	20	210 ± 17	6
0011KS-3	196 ± 30	20	199 ± 23	6
0012KS-1	117 ± 35	10	107 ± 29	6
0011SU-3	231±90	10	188 ± 55	6

[1] the number of single aliquot measurements used

Keywords : optically stimulated luminescence, thermoluminescence, dating, quartz, equivalent dose, dose rate

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