Provenance analysis of muds with luminescence properties
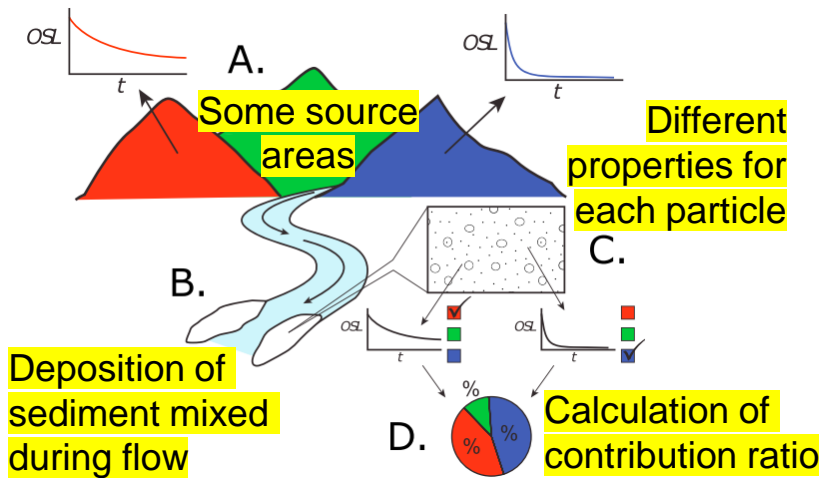
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Objective

Developing a new method for deciphering sediment provenance with luminescence properties

Introduction

A. Some source areas
B. Deposition of sediment mixed during flow
C. Different properties for each particle
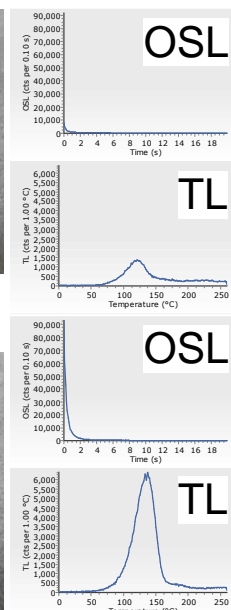D. Calculation of contribution ratio

Luminescence properties

➤ **Intensity** : measurement counts for OSL, IRSL and TL
➤ **Sensitivity** : Intensity / weight of an aliquot
➤ **Component** : signals reflecting differences in luminescence depended on the intensity of the stimulus

Properties of OSL, IRSL and TL depend on source areas of the particles.

Fig 1. Overview of our method for provenance analysis (Gray et al., 2019)

Methods

Feldspar and Quartz samples of silt (4-11 μm)

Sendai Bay

Properties are very different.

Mekong River

OSL
TL
OSL
TL

10% increments → Artifical mixing
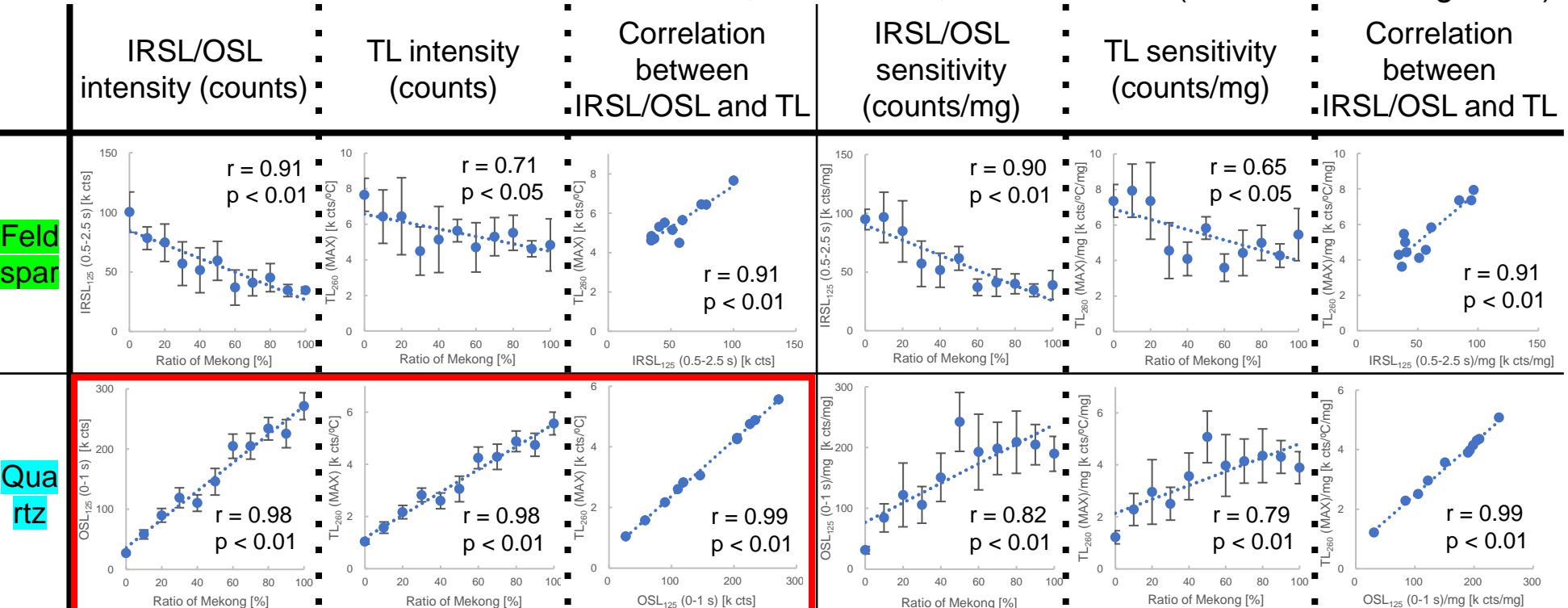
Measurement
（8 aliquots each）

Each aliquot is weighed on an electronic balance. (→ used to calculate sensitivity)

Step	Procedure (Feldspar)
1	Heating until 260ºC at 5ºC/s (Bleach)
2	IR stimulation for 100 s at 125ºC (Bleach)
3	Dose of about 160 Gy
4	Heating until 260ºC at 5ºC/s (TL)
5	IR stimulation for 100 s at 125ºC (IRSL)

Step	Procedure (Quartz)
1	Heating until 260ºC at 5ºC/s (Bleach)
2	Blue LED stimulation for 20 s at 125ºC (Bleach)
3	Dose of about 160 Gy
4	Heating until 260ºC at 5ºC/s (TL)
5	Blue LED stimulation for 20 s at 125ºC (OSL)

Results and Discussion

OSL: 0.5-2.5 s, IRSL: 0-1 s, TL: maximum (subtracted Background)

	IRSL/OSL intensity (counts)	TL intensity (counts)	Correlation between IRSL/OSL and TL	IRSL/OSL sensitivity (counts/mg)	TL sensitivity (counts/mg)	Correlation between IRSL/OSL and TL
Feldspar	r = 0.91, p < 0.01	r = 0.71, p < 0.05	r = 0.91, p < 0.01	r = 0.90, p < 0.01	r = 0.65, p < 0.05	r = 0.91, p < 0.01
Quartz	r = 0.98, p < 0.01	r = 0.98, p < 0.01	r = 0.99, p < 0.01	r = 0.82, p < 0.01	r = 0.79, p < 0.01	r = 0.99, p < 0.01

Correlation: Intensity > Sensitivity
Quartz > Feldspar

➡ The method with OSL and TL intensity of Quartz is suitable.