Reconstruction of glacier fluctuations in the Western Alps since the LGM using OSL surface exposure dating

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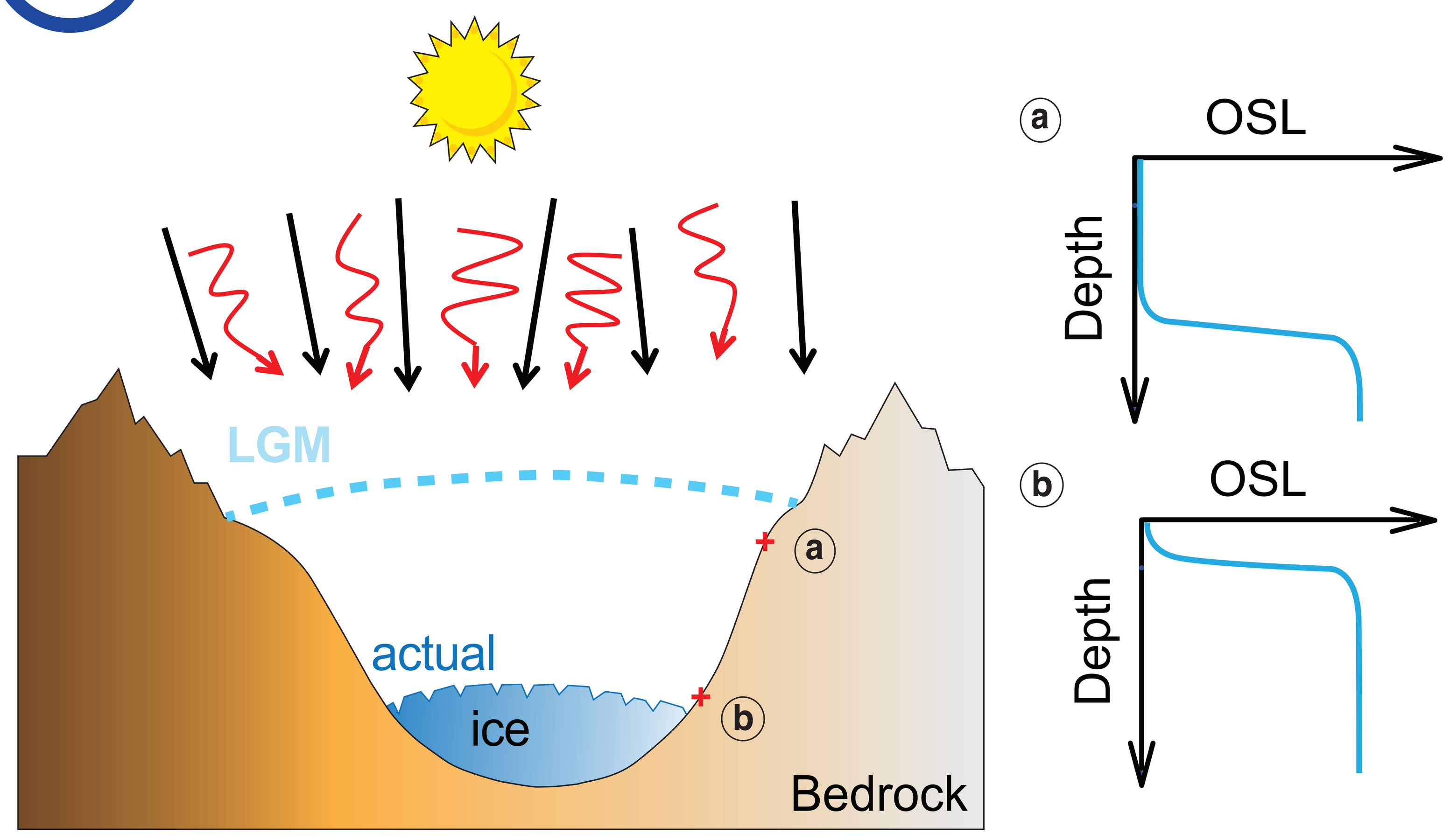
INTRODUCTION

> **Aim:** constrain **glacier fluctuations** and associated **glacial erosion** since the **Last Glacial Maximum** (LGM) in the **Mont Blanc massif**.

> The **glacial extent** over last centuries is known, providing an appropriate natural laboratory to apply **OSL exposure dating** (Sohbati et al., 2011).

> First step: **Calibration** of the **model parameters** using well-dated glacially-polished bedrock samples, in order to describe the **luminescence evolution with rock depth**.

1 Background



Sketch linking glacier shrinkage and luminescence signal evolution of two bedrock surfaces of the glacier at two different elevations.

2 Model

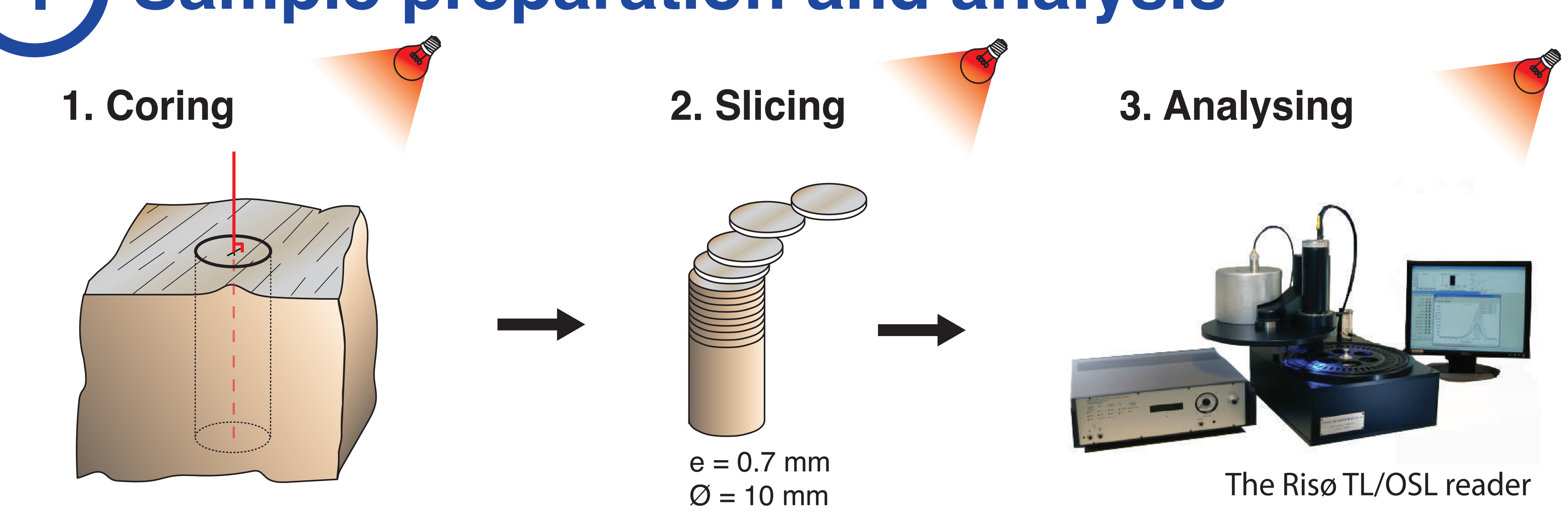
$$\frac{Lx}{Tx}(x,t) = L_0 e^{-\overline{\sigma\phi_0} t e^{-\mu x}}$$

- $\frac{Lx}{Tx}$: Normalized natural luminescence signal measured at depth x (mm) after exposure time t (s)
- L_0 : Maximum luminescence signal intensity at saturation
- σ : Photoinisation cross section (cm²) **MINERAL DEPENDANT**
- ϕ_0 : Mean photon flux (cm^{-2}.s^{-1}) **REGION DEPENDANT**
- $\overline{\sigma\phi_0}$: Effective decay rate of luminescence for a sample directly exposed to daylight (s^{-1})
- μ : Attenuation coefficient of light penetrating through the rock (cm^{-1}) **SAMPLE DEPENDANT**

3 Studied site

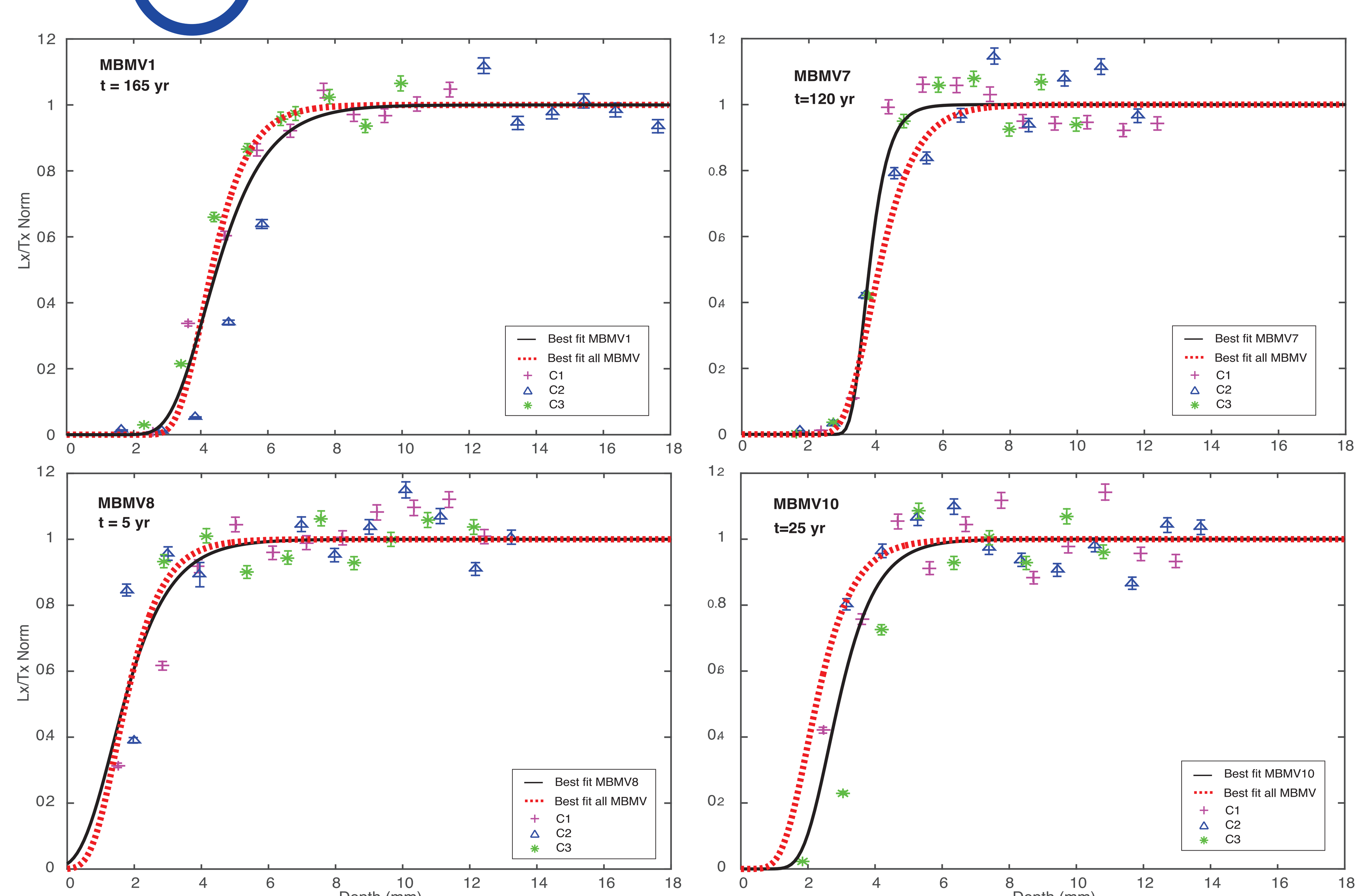
Location of the studied area. Orange dots show the samples from the calibration site (Montenvers), the green strars represent sample sites of the Trélaporte transect located betweenthe LGM glacial upper limit (in light blue, Coutterand et al., 2006) and the present day level (dark blue).

4 Sample preparation and analysis



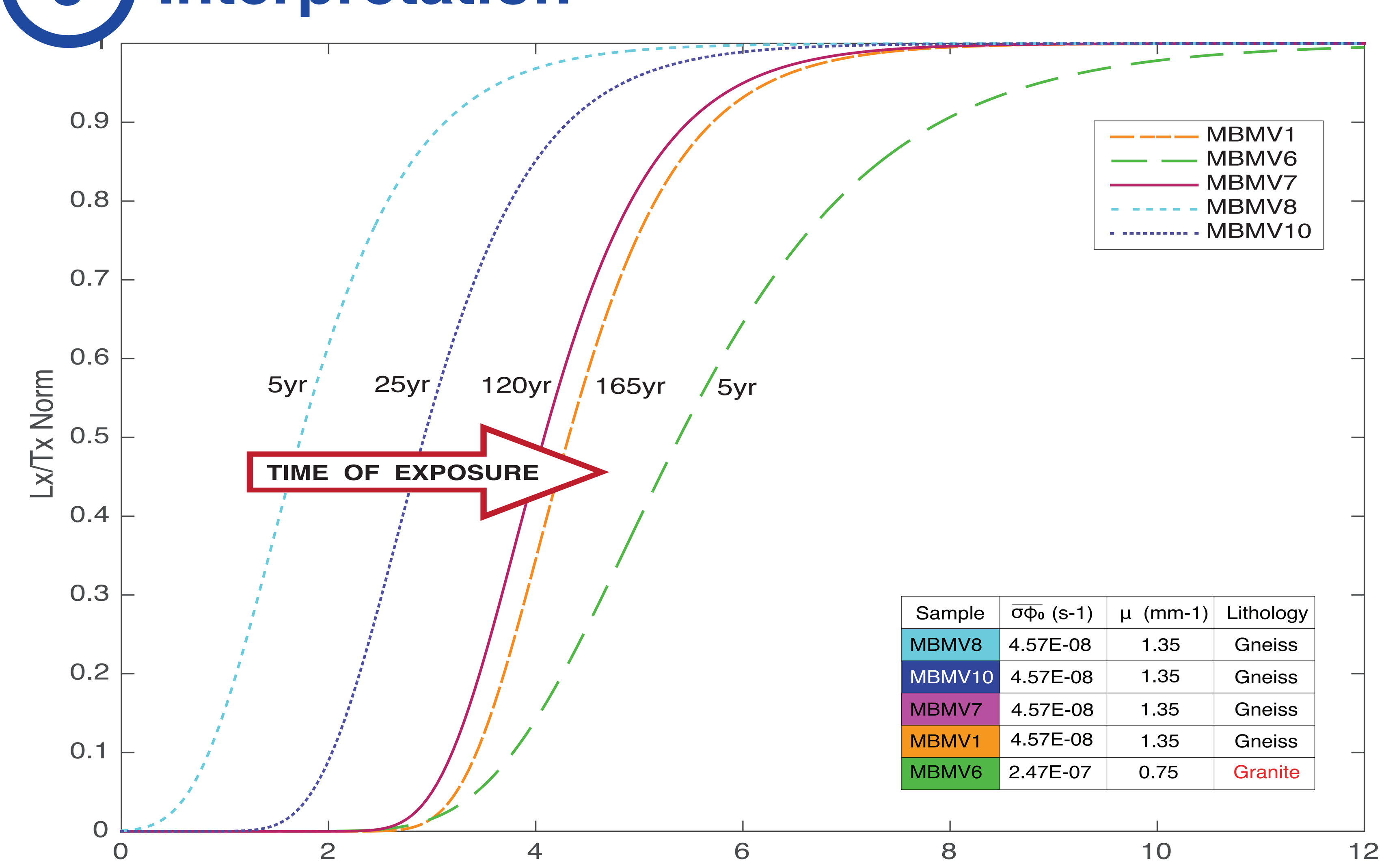
Sketch of the preparation method of the sample from coring (with a Husqvarna DM220 driller, with dril bit of 1cm inner diameter), slicing in 0.7 mm thick discs (with a BUEHLER IsoMet low speed saw mounted with a 0.3 mm thick waffering diamond blade) to analysis (using a RisøTL/OSL reader (model TL/OSL-DA-20 Luminescence Reader) with IR light simulation (λ = 870 nm; LED simulation), detected through a BG3 and BG39 filter.

5 Results



Luminescence profiles with depth and resulting model for bedrock samples from the Montenvers site. Each dots represents data from each rock discs. The black line shows the best-fitting model for each specific sample. The red dashed line represents the best fit calculated for shared parameters between all samples.

6 Interpretation



Sample	$\overline{\sigma\phi_0}$ (s-1)	μ (mm-1)	Lithology
MBMV8	4.57E-08	1.35	Gneiss
MBMV10	4.57E-08	1.35	Gneiss
MBMV7	4.57E-08	1.35	Gneiss
MBMV1	4.57E-08	1.35	Gneiss
MBMV6	2.47E-07	0.75	Granite

Compilation of luminescence evolution with depth for bedrock samples from Montenvers site (Mont Blanc massif, France).

CONCLUSIONS

> The **longer** a surface is exposed to light, the **deeper** the luminescence signal is **bleached** within the rock surface.

> The **lithology** strongly controls the **luminescence signal**.

> The **calibration** on surfaces with **known exposure ages** will allow the dating of bedrock surfaces with **unknown exposure age**.

> **OSL surface exposure dating** is a promising method to perform **high resolution** reconstructions of the paleogeography of mountain glaciers in **space and time**.

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