

Using OSL dating data for quartz provenance analysis in late Quaternary sediments of Amazonia

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BACKGROUND.

This work arose from the necessity of adapting my research project due to Covid-19 restrictions. Instead of collecting and processing new samples, we repurposed data from our archives and tried to obtain additional relevant information to geological studies.

WHAT.

We investigated the use of **OSL dating data for provenance analysis** of sediments based on the sensitivity of the quartz luminescence signal (light emitted per unit mass per irradiation dose).

The quartz luminescence signal sensitivity can be represented as a percentage by the integral of the initial 1 s of the stimulation curve to the total OSL stimulation curve (Eq 1 & Fig. 1):

$$\%BOSLf = \frac{BOSL_{[1s]} - BOSL\ BG_{[1s]}}{BOSL_{[total]} - BOSL\ BG_{[total]}} \times 100$$

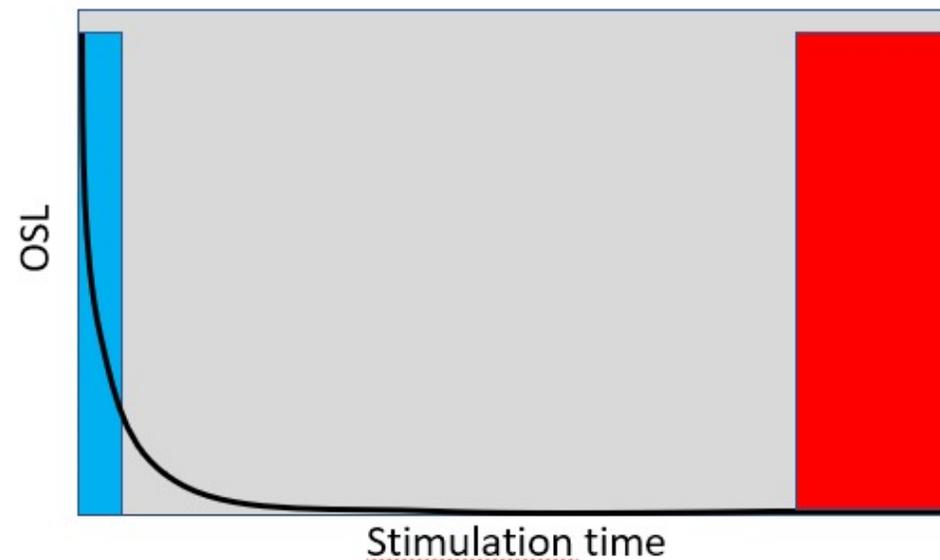


Fig. 1. Conceptual quartz OSL stimulation curve. The blue and red shaded areas represents, respectively, the integral of luminescence counts in the first channels (1s, BOSL_i) and the background channels (last 10s, BOSL_{BG})

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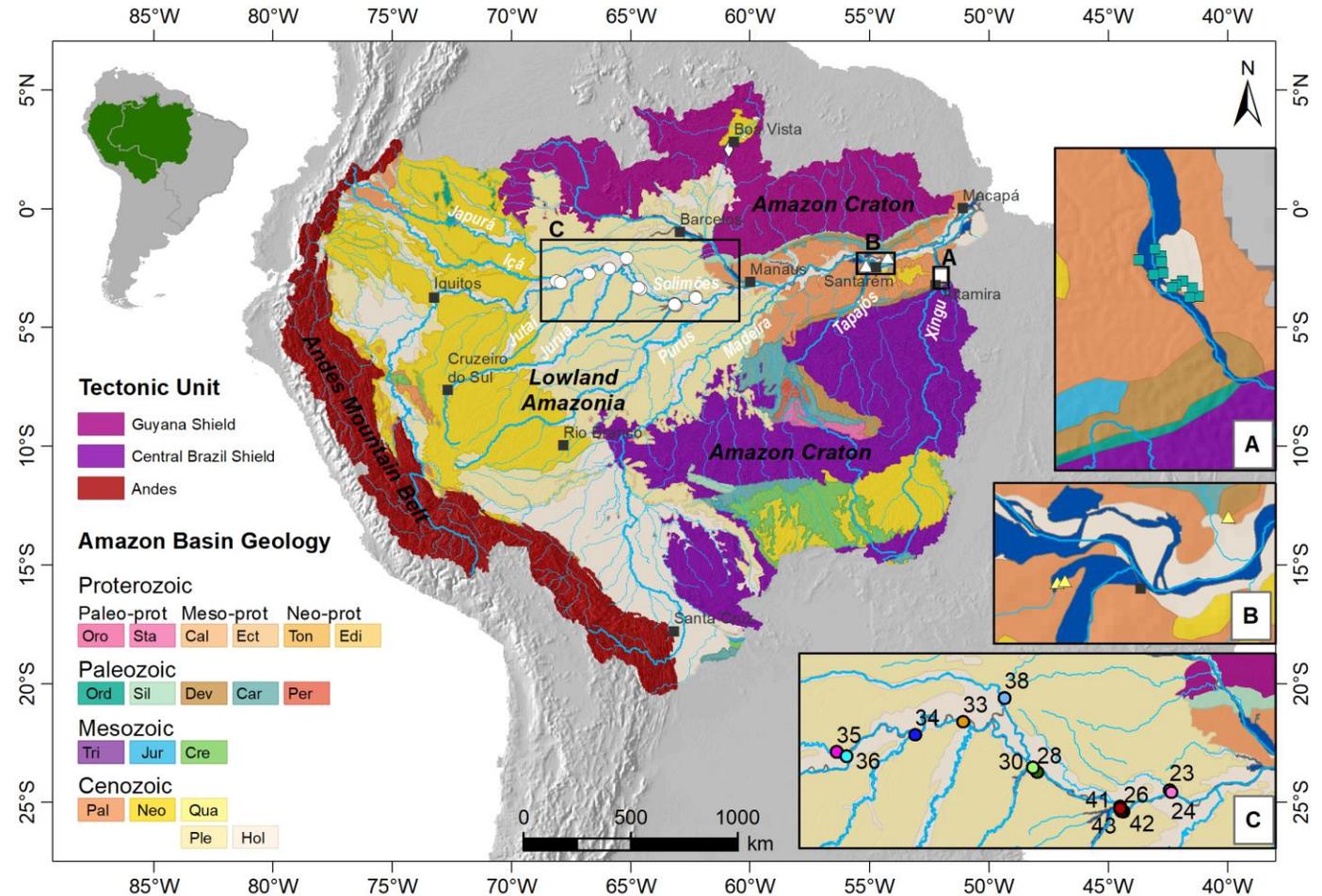
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STUDY AREA.

Three sets of samples from the Amazon basin were selected for our analysis. Two sets are composed of Holocene endmembers which represent the two main sediment sources to the Amazon fluvial system: the Amazon craton and the Andes. The third set is composed of Içá Formation samples, a palaeo-fluvial system whose provenance is not known.

Fig. 2. Amazon Basin Geological map showing its mains river systems and sampling sites location (white filled symbols). Insets A and B show in detail the location of the cratonic endmembers, EMB (Xingu River) and AVA samples (Santarém area), respectively. Inset C shows the location and identifies each sampling site along or near Solimões River, which include both Andean endmembers and Içá Fm samples.



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HOW.

By calculating the %BOSL_f from T_n signals

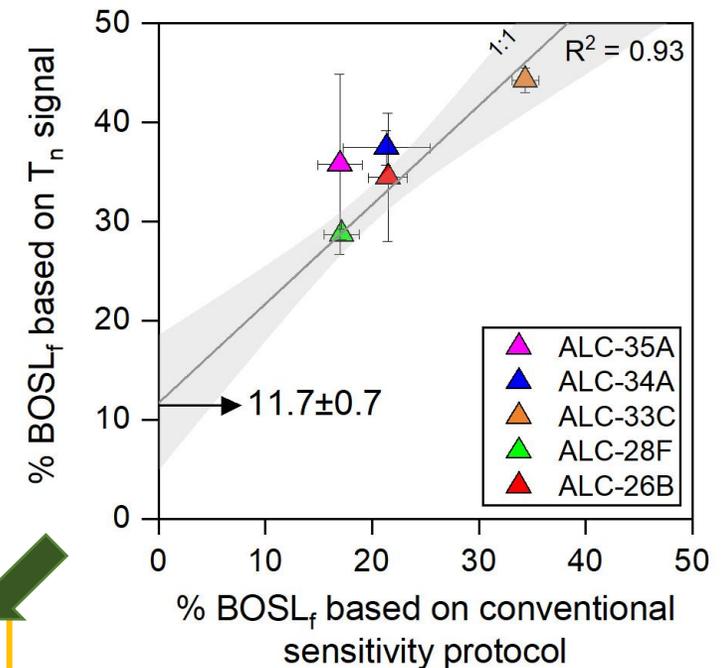
1. Is the outcome comparable to that of the conventional protocol used for sensitivity measurements? (Table 1 & Fig. 3)

Table 1. Typical sequences used for conventional sensitivity (left) and dating (right) measurements

Conventional sequence	Dating sequence
Bleaching: Blue LEDs (100s)	Preheat @ 200 �C (10s)
Dose	Blue OSL @ 125 �C (40s): L _n
Preheat @ 190 �C (10s)	Test dose
IR @ 60 �C (300s)	Cut heat @ 160 �C
Blue OSL @ 125 �C (100s): L _x	Blue OSL @ 125 �C (40s): T _n

There is a good correlation between both protocols, although they are not directly comparable. Sensitivities derived from test dose signals are slightly larger than those derived from the conventional protocol. This difference is of about 12%, if we take at face value the offset in y given by the 1:1 linear fit.

Fig. 3. Comparison between quartz OSL sensitivities derived from conventional protocol (x) and dating data (y). Note the offset of ~12% in y given by the linear fitting line.



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HOW.

2. Comparing the %BOSL_f signature from Içá Fm quartz to the endmembers ones (Fig. 4).

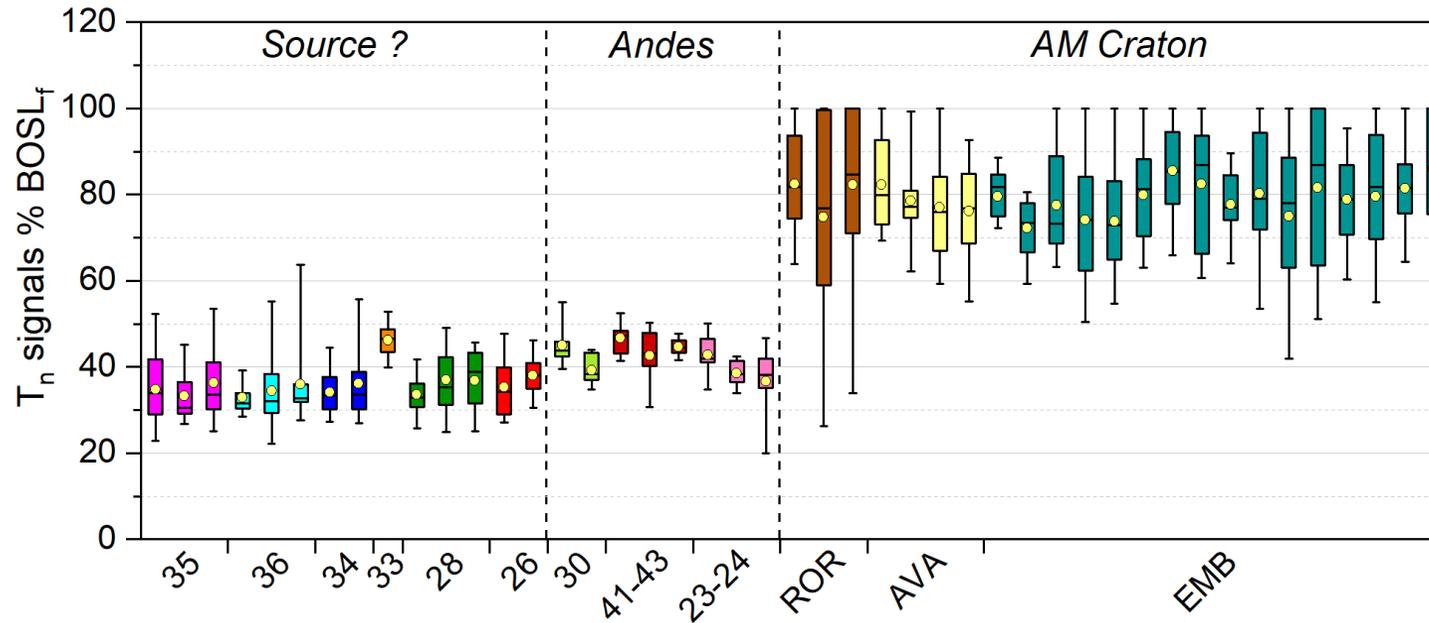


Fig. 4. Boxplots of %BOSL_f derived from T_n signals for all samples.

There is a clear distinction between the endmembers' sensitivity values: the sensitivity of cratonic sediments is on average above 70%, while the mean sensitivity of Andean sediments is below 50%. The sediments from Içá Fm yielded mean sensitivity values as low as those from Andean sediments.

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CONCLUDING REMARKS.

- Dating data can be repurposed for sensitivity analysis, which is useful for provenance analysis;
- The Pleistocene I a Formation deposits in Solim es Basin correspond to those of the Holocene Solim es R. sediments, whose main source is Andean (Fig. 5).

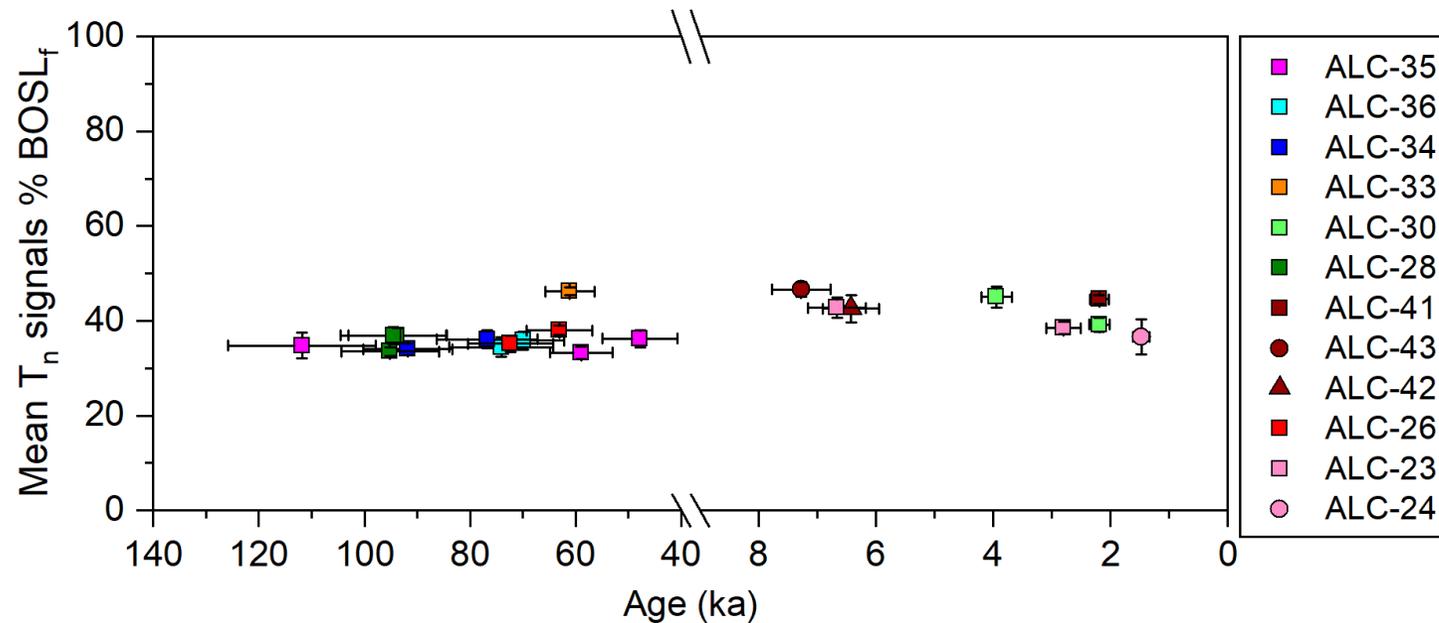


Fig. 5. Mean %BOSL_f (\pm SE) from T_n signals vs samples OSL ages.