OSL DATING THE PANDEIROS RIVER FLOODPLAIN

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1. Background and Goal of the present work

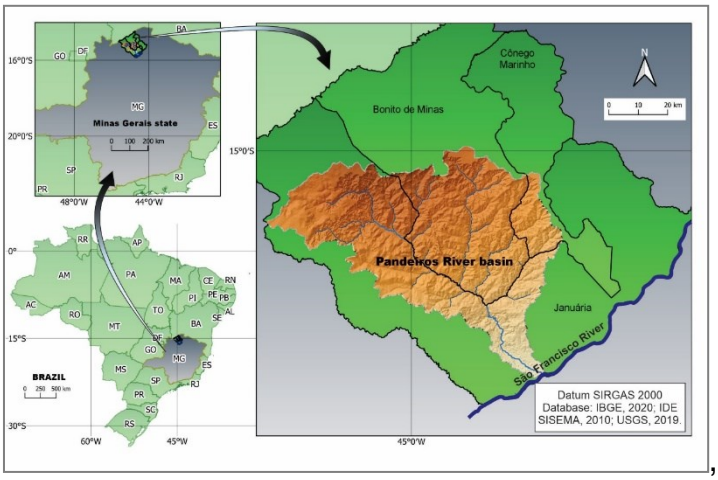
The Pandeiros River Basin (PRB) is located within the Pandeiros Environmental Protection Area (APA Pandeiros), established on September 1, 1995, to preserve the Cerrado biome. Situated in the northwestern region of Minas Gerais, Brazil, the PRB lies on the left side of the middle course of the São Francisco River.

This study investigates the influence of meander migration and excess of moisture on floodplain dating using optically stimulated luminescence (OSL).

2. Methodology

2.1. Location description

The PRB extends across approximately 395,300 ha. Between 2,000 and 5,000 ha, depending on seasonal flooding, are occupied near the river mouth by a wetland known as the "Pantanal Mineiro," which features dozens of marginal lakes that become interconnected during the rainy season. This occurs due to the rising water levels of the São Francisco River, which cause retention of the Pandeiros River flow and partially inundate the area.



Pandeiros River basin location

2.2. Collection of samplers

Ten trenches were excavated for regolith/soil sampling along five equidistant transects perpendicular to the river channel, from upstream to the furthest downstream point within the Pantanal Mineiro. The locations were selected based on the identification of abandoned terraces and their accessibility via existing roads, using Google Earth imagery (2022).

Ground Penetrating Radar (GPR) scanning was conducted using the planned trenches as reference points in two directions: parallel and perpendicular to the river channel. The trenches were excavated on both sides of the river channel, each measuring 1 m in width, 1.5 m in length, and approximately 1 m in depth. Samples were collected at two depth levels: 0.5 m and 1.0 m.

In the Pantanal Mineiro area itself, where distinct riverbanks are absent and the terrain consists of nearly flat sandbars with braided channels, access was particularly challenging due to its remote location. As a result, only two trenches, using the planned trenches as reference points, were excavated exclusively on the left bank.

GPR scanning and trenches' sampling points. Notes: A, B at ~ 0,5 m; C, D at ~1,0 m depth.

2.3. Measurement of Natural Radiation

The natural radiation dose rate to which the mineral was exposed during burial is a key factor in age calculation (EQ 1). Measurements were performed using a portable spectrometer equipped with a BGO ($Bi_4Ge_3O_{12}$, bismuth germanate) crystal (model RS-230, Radiation Solutions), factory-calibrated in August 2019. The dose rate was calculated based on a KUT matrix (potassium, uranium, and thorium), using the concentrations of these radionuclides detected during the assay.

$$Age = \frac{paleodose\ (D_a)\ (Gy)}{dose\ rate\ (D_r)\ (Gy/Y)} \quad \text{(EQ. 1)}$$

where 'paleodose' refers to the radiation accumulated in the sample.

2.4. Dating

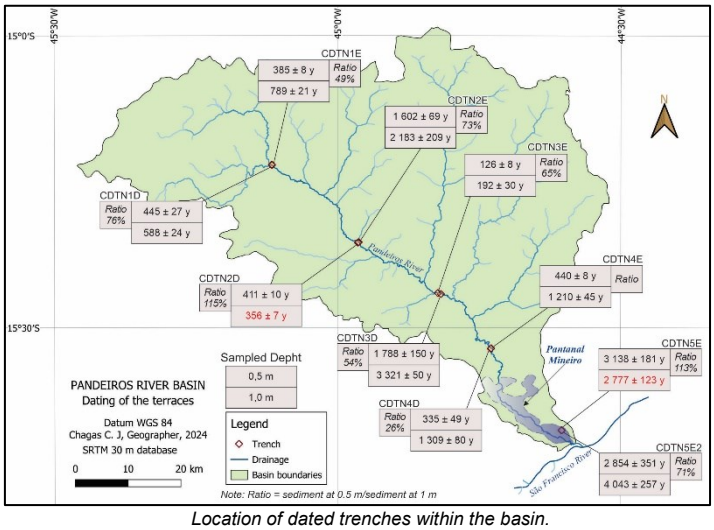
Samples from the trenches were sieved in the laboratory to obtain grain sizes between 180 and 297 µm. From this fraction, a 50 g aliquot was extracted for chemical purification and quartz etching.

To determine the paleodose, twenty-four samples were analyzed using the Single Aliquot Regenerative Dose (SAR) protocol. This protocol compares the regenerated OSL response to the natural OSL signal. To account for variations in luminescence efficiency and trap filling rates between measurements, sensitivity was monitored for each OSL measurement, and corrections were applied to the signal response.

Twelve aliquots per sample were prepared and analyzed using a RISØ TL/OSL reader (model TL/OSL-DA-20) at the Luminescent Dosimetry Laboratory (LDL/SECDOS, CDTN). Dose regeneration irradiations were performed following programmed procedures.

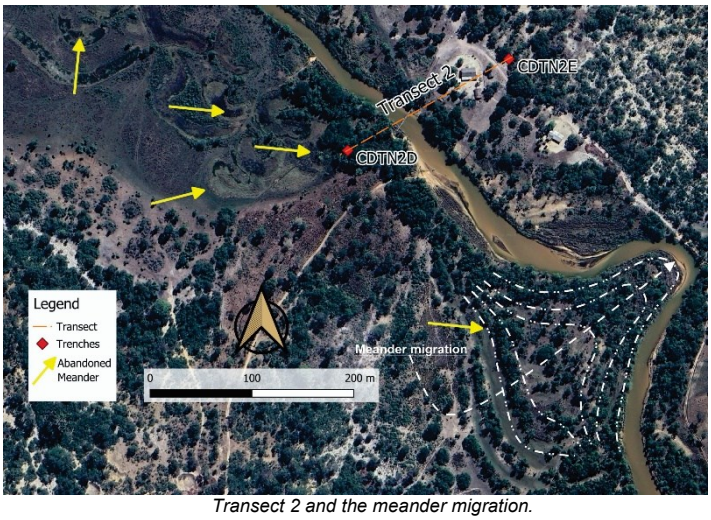
3. Results

Sediment dating, based on their topographic position along the Pandeiros River, follows an expected pattern: samples from the Pantanal Mineiro, near the river mouth, are older. Additionally, sediments from deeper layers at each sampling site are generally older, except for trenches CDTN2D and CDTN5E.



Location of dated trenches within the basin.

In CDTN2D, the presence of younger sediments at the bottom of the trench is likely linked to the meandering dynamics of the Pandeiros River and the radiation shielding effect caused by the excessive moisture of the material (possibly due to a high-water table). This is supported by the updated satellite image from Google Maps ©2015, which shows semicircular patterns of abandoned meanders on both riverbanks, particularly near trench CDTN2D.



Transect 2 and the meander migration.

4. Conclusions

The dating of the alluvial floodplain revealed a typical deposition pattern, with older sediments located in the terraces near the river's mouth. Older sediments were also found in the deeper layers of most trenches, except in two sequences (CDTN2D and CDTN5E). These exceptions are associated with radiation shielding caused by excessive moisture at the trench bottoms, as well as the dynamic nature of meanders in alluvial rivers, which can result in younger sediments being buried beneath older ones.

These results highlight the importance of carefully selecting sampling sites to obtain more accurate dating sequences, depending on the specific objectives of Optically Stimulated Luminescence (OSL) applications