Micromorphology as a tool to interpret glacial depositional environments from late Paleozoic glacial rocks in the Paraná Basin, Brazil

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INTRODUCTION

The understanding that structures developed in unlithified material can be of regional relevance led researches to pay more attention to such features, using methods and principles previously utilized in soil sciences (Maltman, 1984). Soft-sediment deformation can occur in sediments with different stages of lithification and in a big range of geological settings, being commonly studied from the microscope's perspective, though few studies have approched microscale deformation in mass transport deposits and glacially related deposits from the Paleozoic or even older periods, which can be obliterated by subsequent diagenetic events. Our work aims to address this issue and correlate the range of microstructures present in thin section to different depositional seetings, as well as how they relate to each other in a more regional analyses. Besides, characterizing how diagenesis affects those structures is also intended. For such, 38 outcrops were described in the Itararé Group and time equivalent Aquidauana formation (fig. 1), both units having extensive records of the Late Paleozoic Age in the Paraná Basin, Southern Gondwana, Brazil. Then, 31 thin sections of diamictites, sandstones and mudstones were described utilizing the classification of microstructures proposed by van der Meer (1993) and the microstructural mapping method from Phillips *et al.* 2011.

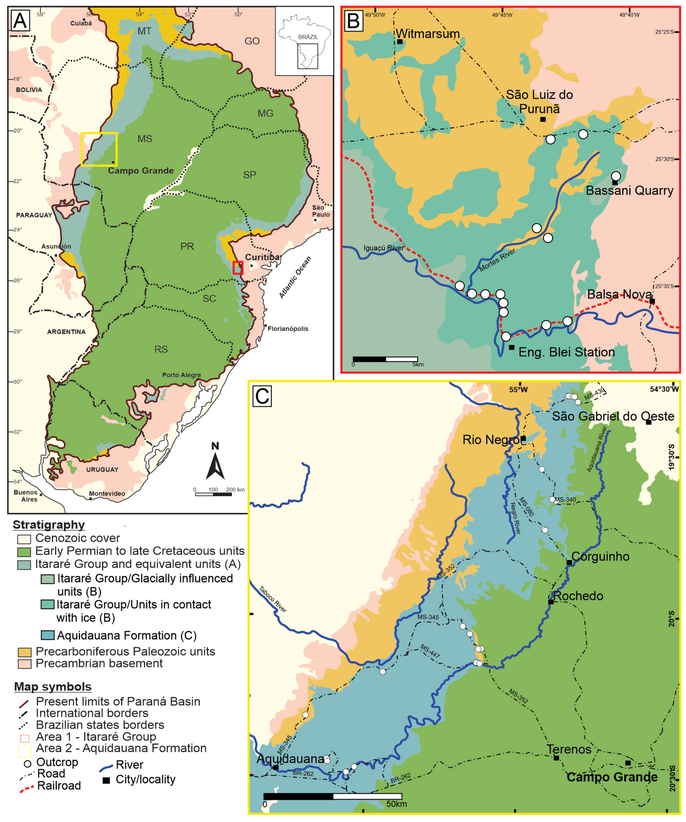

Figure 1: (A) The Paraná Basin in South America with detailed maps of the studied area in the Itararé Group (B) and Aquidauana Formation (C).

RESULTS

In both glaciotectonized deposits and mass trasnport deposits abouding macrostructures were described in outcrops, with different styles of folds and faults being the majority, as well as shear zones (fig.2). As for microstructures, boudin-like, plasmic fabrics, microfolds (crenulations), rotacional structures, sheared clasts, ''shadow pressure'', faults, sand and clay smear, quartz overgrowth, differential compaction and stylolites were described (fig. 3).

- **MACROSTRUCTURES**

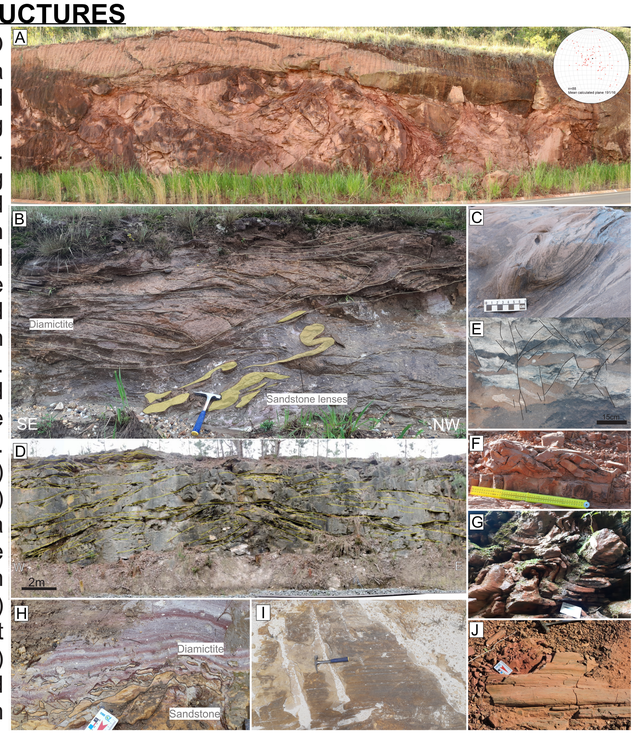

Fig. 2: (A) MTD from Aquidauana Fm., with sheared matrix surrouding undeformed blocks. (B) Thrust with drag folds and deformed sand lenses in glaciotectonized deposit from Itararé Gr. (C) Sheet fold in MTD from Aquidauana Fm. (D) Gentle fold from glaciotectonite in Itararé Fm. Normal faults (E) and folds (F, G) from Aquidauana Fm. (H) Boudin like structures from Itararé Gr. (I) Striated paviment from Itararé Gr. (J) Lineations in fold hinge from Aquidauana Fm.

- **MICROSTRUCTURES**

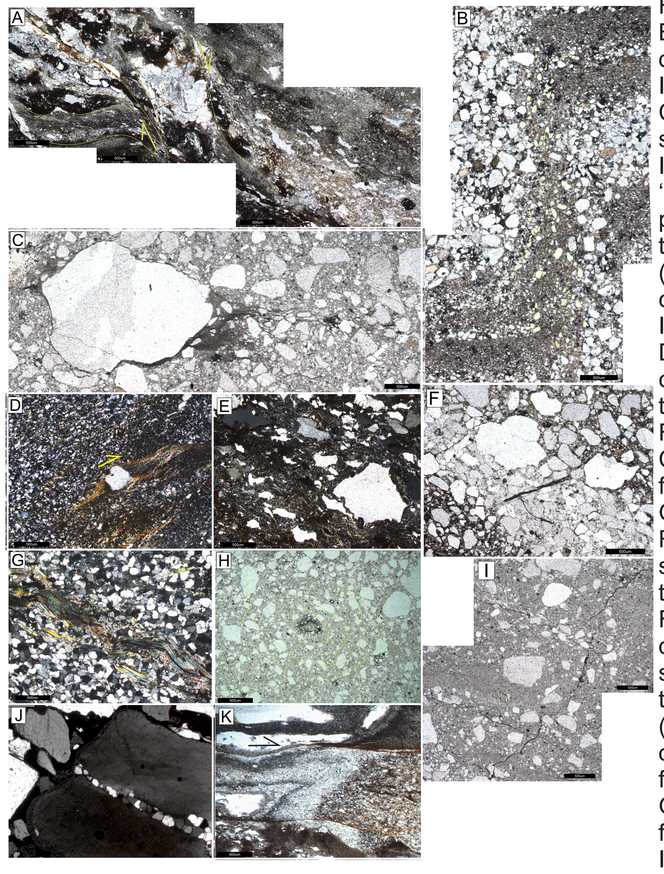

Fig. 2: (A) Boudin like with drag fold from Itararé Gr. (B) Clay and sand smear from Itararé Gr. (C,D) ''Shadow pressure'' from the Itararé Gr. (E) Sheared clasts from the Itararé Gr. (F) Differential compaction from the Aquidauana Fm. (G) Crenulated mics from the Itararé Gr. (H) Rotational structure from the Aquidauana Fm. (I) Two directions of stylolites from tthe Itararé Gr. (J) Quartz overgrownth from the Itararé Gr. (K) Shear fold from the Itararé Gr.

- **MICROSTRUCTURAL MAPPING**

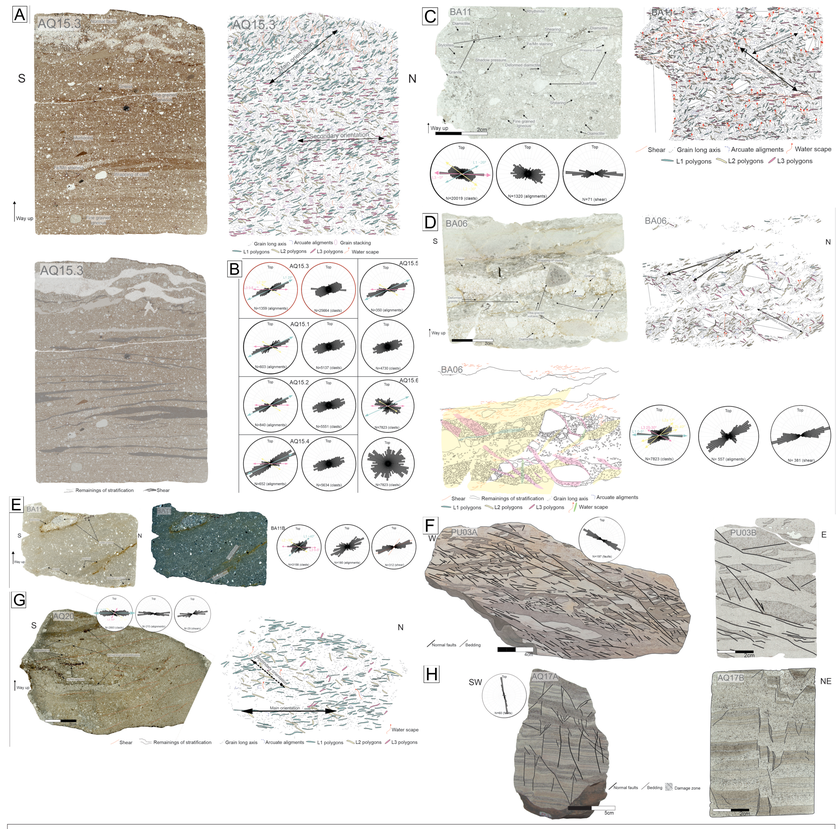

Fig. 3: Microstructural maps of the samples (A)AQ15, with six different thin sections being mapped (B) - Aquidauana Fm. (C) BA11 - Itararé Gr. (D) BA06 - Itararé Gr. (E) BA10 - Itaré Gr. (F) Mapping of faults from sample PU03 - Itararé Gr. (G) AQ20 - Aquidauana Fm. (H) Mapping of faults from sample AQ17 - Aquidauana Fm.

CONCLUSIONS

- There are many sets of microstrucutres and macrostructures that can be identified in rocks from the Late Paleozoic Ice Age at the Paraná Basin;
- Although the sets have minor differences between them, the microstructures alone are not enough to distinguish mass transport deposits from glaciotectonizes rocks. Utilizing a combined method with facies, stratigraphic and structural data is more efficient;
- Diagenesis do obliterate microstructures and can completely erase them, specially in rocks with minor content of matrix. But in most of the diamictites described microstrucutres were preserved;
- It is possible to correlate microfabrics from the microstructural mapping in a regional point of view, but it's shown that local characteristics (such as water and clay content and pore pressure) play a major role in the formation of clasts alignments, making such correlation not 100% accurate.

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