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

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The Itararé Group and time equivalent Aquidauana Formation represent the Late Paleozoic Ice Age in the Paraná Basin. These sedimentary rocks provide an extensive glacial record which contains deformed intervals interpreted as glaciotectonites, with features such as folds, thrusts and subhorizontal shear zones, which could be produced sub- or proglacially. In addition, similar deformation structures have been recognised reflecting different depositional processes in glacial related environments, such as subaqueous mass flows, iceberg keel marks and ice-rafting. Micromorphological analysis of glacially-related soft-sediment structures have been widely applied to Quaternary deposits as a tool to aid in the interpretation of paleoenvironments. However, few studies have approached microscale deformation in glacial and glacially-related deposits from the Paleozoic or even older periods, in which the distinction between subglacial, proglacial and non-glacial products is crucial for deep-time paleoclimatic reconstructions.

Our work aims to address this issue and correlate the range of microstructures present in thin section to different depositional settings interpreted on the basis on macroscale sedimentary facies analysis. The results are used to critically evaluate the applicability of micromorphology in distinguishing paleoenvironments in the pre-Pleistocene glacial record and how those structures can be modified over time in response to lithification and diagenesis. The study combines field data with detailed micromorphological and microstructural analysis of 40 thin sections from the Itararé Group and the Aquidauana Formation. Samples were collected from a range of lithotypes from different depositional settings including: diamictites, sandstones and mudstones from rain-out, mass transport, subglacial overriding and ice-marginal glaciotectonism. The microstructures present include unistrial plasmic fabrics, glaciotectonic laminations, rotational structures (turbates), microshear zones, sheared clasts, faults, folds, boudins and intraclasts. However, in some well-sorted facies, which contain very little or no matrix, also contain features typically associated with compaction and diagenesis, such as grain crushing, reduction of primary porosity, sutured grain contacts and stylolites.

Preliminary results show that sediments from a range of different depositional facies may contain

a similar assemblage of microstructures. This suggests that microstructures on their own cannot fully characterize the original sedimentary depositional environment in older glacigenic sequences. Furthermore, diagenesis plays a major role when it comes to the preservation of primary sedimentary and soft-sediment deformation features and can lead to the overprinting of these structures.