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Metripol analysis as a tool for measuring iceberg sub-scour bulk strain in sediment

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Iceberg scour deforms sediment, realigning clays and silts into particular birefringent optical arrangements called plasmic fabrics that can be identified using a petrological microscope. Plasmic fabrics provide valuable information on the style and intensity of bulk strain in sediment, which is critical to engineering analysis when evaluating the effect of iceberg scour on pipelines. In the past, the analysis of plasmic fabrics and thus strain in sediment has been largely subjective by adopting descriptive methods. Now however, with 'Metripol' analysis we are able to move to a more quantitative, objective approach for assessing strain in sediment and sedimentary rocks. Here Metripol is pioneered as a new, non-destructive, optical microscopy technique for automatically recording and quantifying plasmic fabrics, providing digitised, empirical measures of sub-scour bulk strain in iceberg scoured sediment from former Glacial Lake Agassiz (Manitoba, Canada). Colour-coded images are produced where colour represents birefringence (relative optical retardation) and azimuth lines represent optical orientation. Results show that the better developed the plasmic fabric (as seen under a standard petrological microscope) the higher the birefringence, the larger the areas of high birefringence, and the longer and more densely populated the azimuths under Metripol - all of which indicate high strain deformation associated to iceberg scour. However, some plasmic fabrics that are subjectively 'perceived' as highly birefringent under a standard petrological microscope demonstrate weaker birefringence when objectively measured under Metripol. This is particularly true in clay-rich sub-scour sediment and holds implications for the way we currently describe and interpret plasmic fabrics and strain in sediment. Finally, identification and quantification of additional structures in iceberg scoured sediment that would otherwise have gone undetected using a standard petrological microscope (e.g. linear structures that are likely to represent shears), highlights the potential for Metripol to gather additional information on the strain history of sediments that standard techniques cannot. All results from this research will eventually be used to help in constraining numerical models of bulk strain in response to iceberg scour.