Refining the Assessment of Ice Rafted Debris Abundance in Sediment Cores Using Combined X-Ray Imaging and Sedimentology

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Ice-rafted debris (IRD) abundance is a key proxy for interpreting iceberg calving in the context of other climate-sensitive evidence in marine sediment cores. Multiple methods exist for quantifying IRD, and resulting records may not entirely agree due to different volumes and grain sizes targeted. Additionally, non-IRD material may appear as high density areas in X-ray images, and as mass in weighed samples. Data from International Ocean Discovery Program (IODP) Site U1537 contains an example of disagreement between X-ray counted and sieved IRD records. In an interval of anomalous regional warmth from 2.4-2.1 Ma, IRD abundance based on sieved discrete samples is low while X-ray counted IRD from archive section halves is high, despite agreement between the two outside of this interval. Two hypotheses are proposed: too-low resolution of discrete samples missed high IRD intervals, or misidentification of IRD occurred in X-ray images. To investigate, we doubled the sampling resolution of the sieved IRD record and integrated sedimentological observations with X-ray imagery. This higher-resolution sieved record captures some previously unidentified peaks in IRD, but the sieved and X-ray counted records remain inconsistent with each other in smaller sections. The interval of disagreement coincides with abundant pyritized burrows discerned as filamentous shapes in X-ray images. Examination of discrete samples from the low interval under the microscope reveals numerous pieces of cemented aggregates containing microfossils and pyrite. These cemented aggregates are not IRD, indicating sieved weight percents should be even lower with the exclusion of the cement aggregates. We suggest that pyritized burrows and related diagenetic alteration features can resemble IRD in X-ray images. We propose initial documentation of heavily pyritized intervals for targeted sedimentological ground-truthing when constructing X-ray derived IRD records, and that discrete sampling would be improved with a plan based on observation of X-ray images. Such integration of X-ray and discrete sample evidence will improve confidence in IRD reconstructions and should be used in future work from legacy scientific ocean drilling cores to improve interpretations of past ice sheet behavior.