SCOR WG123- discussion report

SEDIMENTARY BASED CIRCULATION PROXIES

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The major proxies/approaches discussed within this breakout group included:

(1) grain size distribution of the fine terrigenous sediment component for reconstructing near bottom flow speeds (Sortable Silt mean size, $\overline{SS}$);
(2) inverse modelling of grain size distributions for reconstructing flow speeds and sediment dispersal patterns (End-member modelling);
(3) environmental magnetism: magnetic grainsize (κ_{arm}/κ and hysteresis parameters); magnetic mineralogy (S-ratio, HIRM) for sediment dispersal patterns and sources;
(4) radiogenic isotopes to trace detrital sources and sediment dispersal patterns.

It was recognized that the relationship between current speed and sedimentary parameters offers the only palaeoceanographic proxies giving direct evidence of the intensity of the deep-sea circulation. A considerable hindrance to the application of, for example, the $\overline{SS}$ proxy is that it has yet to be calibrated in terms of flow speed and presently gives only relative changes. Considerable discussion was held on the possible approaches that could be adopted in order to achieve a dependable flow speed calibration. McCave outlined a project currently underway in which core-top samples have been collected from locations close to long term (>1 year) current metered sites with instruments set within 100 m of the seabed (giving the mean and variability of flow speeds from just above the boundary layer). Derived properties from the current meter data, such as scalar mean speed, mean and eddy kinetic energy, directional variability, percentage exceedance of speeds above given values which relate to sediment deposition/erosion/winnowing are being correlated with sediment parameters in order to determine the best relationship. McCave was fairly confident that this exercise could, within <1 year, allow us to perform the inverse operation and infer calibrated local flow speeds from downcore grain size properties. However, the enterprise has encountered problems such as the meters of line ICM-3 in the deep western boundary current in the Madagascar Basin having been laid in and around a turbidity current channel. New meters in the UK *RAPID* programme should provide new coring targets.

A significant improvement over existing methods may be achieved by combining the sortable-silt proxy with the end-member model to distinguish effects of selective deposition from mixing of sediments from multiple sources. Results of such integrated grain-size studies could be checked by exploiting the fact that chemical and radiogenic provenance indicators extracted from narrow grain-size ranges are in principle independent of selective transport. The simultaneous evaluation of provenance and dispersal-related grain-size variations will broaden the range of situations in which sediment-based palaeoflow reconstruction are likely to be successful.

The group was optimistic that within a timeframe of a few years it would be possible to achieve a flow speed reconstruction at a millennial (and possibly multi-centennial) temporal scale of the precursor water masses constituting NADW (ISOW, DSOW and LSW) over the past 40,000 years. This could be augmented with similar

time-slice maps showing sediment dispersal patterns and sources. It was agreed that this could be achieved through the examination of rapidly-deposited sedimentary sequences recovered from near the source areas of overflow water masses in the North Atlantic.

Finally, the importance of multi-proxy studies focussed on individual cores that combine complementary proxies along with those that have similar characteristics (i.e. overlapping proxies) was discussed. It was felt that this approach should be encouraged within the Working Group as a way to increase confidence in selected individual proxy records.