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Ice sheet conditions in western Ross Sea (Antarctica) during LGM from micromorphological marine core observations

C. Baroni (1,2), F. Fasano (1, 3) and **F. Finocchiaro** (4)

(1) Dip. Sc. Terra, University of Pisa, Italy, (2) CNR, Istituto di Geoscienze e Georisorse, Pisa, Italy, (3) Dip. Sc. Terra, University of Siena, Italy, (4) Dip. Sc. Geologiche, Ambientali e Marine, University of Trieste, Italy (finofu@univ.trieste.it / Fax: +39-040-5582048)

Massive diamicton is a common lithofacies in high latitude continental shelves and can be found in most of gravity and piston cores collected in the Ross Sea. From the pioneering paper of Kurz and Anderson (1979), many authors has tried to distinguish between two types of diamicton in marine cores. The problem is to evaluate environmental conditions at ice-sediment interface. Recently micromorhological studies on impregnated sediments has given new chance to increase knowledge about glacial deposition mechanisms.

In a marine sediment core (ANTA 99-cD38: Lat. 75˚ 57.6' S, Long. 164˚ 54.6' E; water depth: 888 m, recover: 284.5 cm) from Nordenskjold Basin (south of Drygalski Ice Tongue) a stratigraphic sequence including pre–LGM deposits has been found (Finocchiaro et al., 2007). Three units have been recognised in the core from sedimentological and compositional parameters; the micromorphological observations have confirmed this classification adding fundamental information on textures and structures of the sediments.

The upper unit is a diatomaceous mud, and is deposited under marine, post glacial environment, with high diatoms productivity during Holocene. Under the microscope the sediment is highly sorted, faintly laminated and without deformation, confirming the open water depositional conditions.

The intermediate unit have been sedimentologically classified as a glacial diamicton. At upper / intermediate boundary micromorphological texture evidences switch to a very poorly sorted diamicton, with a sharp change from “monic” to “porphyric open space” coarse vs fine related distribution. Rotational features and reworking clues are widespread, meaning deformation under the glaciotectonic action of a soft and wet sediment; also reworked intraclasts and “rolling ball structures” (sensu Baroni and Fasano, 2006) are well visible. This sediment assumes the more appropriate name of “tectomict” (van der Meer et al, 2003).

The lower unit is again a biosilicious mud, but with reduced water content and very stiff. Two radiometric datings has set the age of the unit to the end of MIS3, so this sediment is evidence of open water conditions pre-LGM in the western Ross Sea. In thin section the boundary between intermediate and lower unit is characterized by several planar structures, water escape structures, reworking features and a general highly deformed aspect. Some truncated structures (planes and injection veins) suggest that, at this level, the high deformation is accompanied by intense shear and material translocation. The lower unit is texturally similar to the upper unit, that is a marine silt belonging to open water marine conditions. The same lower unit is structurally akin to the intermediate one, that shows very high deformation, linear features, rotational and reworking structures. Kink banding, never recognized in the former units, suggests more confined and uniform stress conditions.

Both sedimentological and micromorphological dataset support the unit division. A diamicton is comprised between an undeformed silt (upper) and deeply deformed silt (lower). The intermediate and the lower unit show similar deformation, both pervasive, related to shear, rotation and reworking. The boundary between the two lower units is marked by the presence of a deformational belt. All these information lead to understand that a strong stress field acted in a non-frozen sediment.

The strain involved all levels of the two deformed units (intermediate and lower) and it is related to LGM advance upon soft muddy biogenic sediment; on the contrary the upper unit is younger respect to the deformation age.