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Glacial Ordovician new evidence in the Pakhuis Formation, South Africa : sedimentological investigation and palaeo-environnemental reconstruction

E. Portier (2), JF. Buoncristiani (1), and JF. Deronzier (2)

(1) Universite de Bourgogne, Biogeosciences, Dijon, France (jfbuon@u-bourgogne.fr), (2) GDF SUEZ – Direction Exploration Production, 266, avenue du Président Wilson, 93200 La Plaine-Saint Denis, France

During the Late Ordovician (Hirnantian) an ice sheet covered a great part of the Gondwana. In Africa, several studies present the stratigraphy and the complexity of these glacial records. The different glacial landsystems correspond to several glacial cycles, related to rapid ice front oscillations and are grouped into two major ice-sheet advances, separated by a major ice sheet recession.

The study was performed on three well outcropping Late Ordovician sections in South Africa. The Ordovician IV is described as the Pakhuis Rm, and is divided into three different lithological members (known as Sneekop, Oskop and Sternbras Mb) that could be related to two major glacial cycles. In the first cycle (pool the two first Mb), facies association indicate continental environment, with : massive sandy tillites with facetted and striated erratics, subaerial outwash plain to glaciolacustrine cross bedded sands and laminated silts. Near Clanwilliam, the outcrops exhibit a high lateral variability in facies and thickness, ranging from a few meters to several tens of meters. The second cycle is dominated by clear marine sedimentation and may be interpreted as a transgressive sequence, quite different from what occurred in North Gondwana. Typical facies define shoreface environment, and periglacial evidence such as dropstones at base are encountered, passing progressively to a clear offshore environment at top of the series, likely Silurian aged, and known as Cederberg fm.

Two glacial pavements were also described. The most spectacular one was firstly described by Visser et al. 1974 and should be interpreted as an intra-formational glacial pavement, with striae indicating a flow from East to West. This pavement is overlying a newly discovered glacial floor which exhibits grooves, crescents marks, en echelon fractures, with the same E-W general orientation, and shaped as ‘roches moutonnées’, which are typical evidences of glacial erosion on indurated substratum.
Reconstructing paleoenvironment suggests a clear structural paleo-topography controlling the erosion and distribution of paelo-valleys, lakes and glacial lobes.

The glaciogenic Ordovician deposits constitute a proven oil and gas bearing reservoir on the North Gondwana margin, also known for their sharp and rapid facies changes. Also, such a study provides an excellent opportunity to understand and appraise the complex architecture and geometries of the sands bodies, the structural control of the glacial erosion and infill of this promising play.

Visser, 1974 J.N.J. Visser, The Table Mountain Group: a study in the deposition of quartz arenites on a stable shelf, Trans. Geol. Soc. S. Afr. 77 (1974), pp. 229–237.