Refined lithofacies codes for poorly sorted sedimentary rocks (diamictites) with an example from the Upper Ordovician of southern Bolivia

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Lithofacies codes for the description of poorly sorted sedimentary rocks as defined by Eyles et al. (1983) became widely accepted and were used mainly for the description of glacial diamictites (tillites in a broad sense). However, these codes were criticized, because they include interpretative aspects, restrict their application for non-glacial diamictites, do not consider smaller variations in grain size and are not suitable for refinement by laboratory methods (Moncrieff 1989, Miller 1995). Moreover, the term “matrix“ (and hence the differentiation between matrix-supported and clast-supported diamictites) is poorly defined, especially for nonsorted sedimentary rocks.

The 180 m thick succession of the Late Ordovician Cancañiri Fm. in southern Bolivia could not be described properly with this “classical” method. The diamictites would have been classified almost completely as “matrixsupported”, massive diamictites (Dmm) and no subdivision into distinct facies units or partial successions would have been possible. Nevertheless, these sedimentary rocks show in part significant variations in the content of the pelitic or sandy fraction and of gravel (clasts).

A triangle of grain sizes has been used by Folk (1954) for the classification of poorly sorted sedimentary rocks. To include an accurate definition and a subdivision of the term “diamictite“ this scheme was modified by Moncrieff (1989). With some smaller modifications of this triangle diamictites could be classified into 3 categories (clast poor, normal and clast rich) and subdivided with the criteria of the sand/mud-ratio (muddy, intermediate and sandy). To use the advantages of the incorporation of sedimentary structures into lithofacies description (Eyles et al. 1983) this grain size classification was used as a base for the development of a strictly descriptive scheme of lithofacies codes. To specify the obtained 9 classes, 15 additions to the code describing sedimentary structures and 6 specifications of grain size (especially for the end members of the triangle) were introduced.

With these refined lithofacies codes the succession of the Cancañiri diamictites at the locality Sella in southern Bolivia could be described in their vertical and lateral variability. Three lithologically different stratigraphic units, which reflect three advances of ice shields, could be recognized. Each of these units shows a different assemblage of distinct lithofacies types of diamictites and associated sorted siliciclastics. The classification of lithofacies based on grain size distribution could be verified by microscopic analysis of the thin sections of representative samples.

This subdivision of the Cancañiri-facies provided the base for the discussion on the glacial or non-glacial origin of the sedimentary rocks. In this way it could be concluded that the diamictites were deposited directly from a grounded glacier or ice shield (tillites in the restricted sense; Schönian et al. 1999). These codes may serve as a working tool for the description of massive diamictite successions in general. Therefore they could help to solve such an essential sedimentological and paleoclimatological problem like the origin of poorly sorted sedimentary rocks.

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