Turbidites in the Eocene of Spitsbergen: can they tell us something about the Sørvestsnaget Basin?

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The Eocene of Spitsbergen, Svalbard, has received considerable attention in the literature because of its spectacular seismic-scale clinforms exposed along many fiords and valleys. High quality outcrops enables down-dip tracing of facies belts from the proximal shelf through the shelf-edge and down-slope into the basin floor. Previous publications particularly focused on the shelf-edge to slope segment of the clinoforms and demonstrated how shelf-edge deltas played a major role in sediment transport into the deeper parts of the basin. Thick, sandstone-dominated turbidite lobes occur in the toeset of some clinoforms. Few studies have investigated in detail these turbidite deposits. By combining outcrop and core data from central Spitsbergen, this study investigates the sedimentary processes that formed the turbidite lobes. Our previous studies shows that turbidite lobes occur in two basin-wide NW–SE-oriented zones. In areas with multiple stacked turbidite lobes, the lobes show an offset stacking pattern. Internally, lobes shows proximal to distal (or axis to off-axis) facies trends with beds thinning distally, as well as vertical facies trends characterized by an upwards increase in bed thickness and degree of amalgamation. These trends together indicate that the turbidite lobes are progradationally stacked, reflecting the overall progradational nature of the accompanying clinform system. At bed-to-bed scale, many of the turbidites deviates from the classical Bouma-type facies pattern typical of deposition from surge-type, low-density turbidity currents. Many beds instead show a two- or three-fold-division typical of hybrid sediment gravity flows. These beds have a lower sandstone-dominated turbidite division succeeded by a clast- and mudstone-rich debrite division (see inset photo). Some beds also have an upper thin-bedded turbidite division deposited from the dilute tail of the flow. The two-folded bed division indicate that some turbidity flows transformed into slurry flows or debris flows on their way to their final destination on the basin floor. Many of the thicker sandstone beds and bed-sets show pervasive soft-sediment deformation and high degrees of amalgamation, particularly in the upper part of most lobes. The latter may be attributed to high sedimentation rates in the proximal and axial regions of the lobes.

Sand-rich turbidite deposits also occur in the middle Eocene of the Sørvestsnaget Basin, western Barents Shelf. Well 7216/11-1S penetrate parts of what is interpreted to be a submarine fan that developed in a high-relief shelf-margin setting. A cored section indicate that the turbidite beds in this particular submarine fan was deposited by high-density turbidity currents (see paper by Ryseth et al., 2003). The succeeding clinform succession accreted in a low-relief shelf-margin setting similar to that of Spitsbergen. Although undrilled seismic features, high-amplitude anomalies in the toesets of these clinoforms may indicate the presence of sandy turbidite deposits. We suggest that the turbidite lobes in Spitsbergen may be an outcrop analogue to those reported in the Sørvestsnaget Basin and may aid future exploration campaigns in the western Barents Shelf.

Fig. 1: Clinoforms in the mountainside of Storvola, central Spitsbergen. The inset show a hybrid event bed.