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Submarine flow discharge changes as a way to explain incission-overspilling and other cycles in submarine channel sequences

J.P. Milana (1), B. Kneller (3), and M. Dykstra (4)

(1) Universidad Nacional de San Juan, Instituto de Geología & CONICET, Rivadavia, Argentina (jpmilana@gmail.com), (3) Department of Geology & Petroleum Geology, University of Aberdeen, King's College, Aberdeen, AB24 3UE, Scotland, UK., (4) Colorado School of Mines, Colorado School of Mines, Department of Geology and Geological Engineering, 1516 Illinois Street, Golden, Colorado 80401, U.S.A.

Many studies mainly made in subsurface slopes systems using 3D seismics supported by drill data, suggest that these environments behave cyclically, with the geological time at proximal and intermediate positions in the slope, divided in times in which erosion and elaboration of deep channels prevail and thus bypass of the sediment towards lower areas, and epochs in which accumulation prevails occurring by the development of depositional leveés and eventual widening of the channel system with some over spilling possible. To understand which are the ruling mechanisms of these cycles we study in detail the depositional processes that occur at the Rosario Fm (Baja Ca, Mexico), one of the best exposed canyon and channel-levee systems.

We centered this study in the gravel fractions of the system assuming that they would indicate the transport modes of the most energetic flows. After analyzing both the bed structure and facies, and the particular conglomerate fabric at certain types of large-scale bed structures, we concluded that conglomerate deposition was by simple traction mechanisms, quite comparable to what occurs at some highly concentrated and fast fluvial streams. The main difference to fluvial hyperconcentrated tractive flows lies on bedform types and scales, as bed architecture might be at one order of scale larger than fluvial systems. Most of these conglomerates can thus be explained as deposited by known bedload mechanisms, without the need to call for hypothetical mechanisms as traction-carpet freezing, sweep fallout, etc.

The bedload dominated flows responsible for gravel transport produced the bed structures due to migration of three main bedforms at different balances of erosion/accumulation. These three bedforms are gravel waves, a subcritical bedform comparable to gravel dunes, capable to produce very large-scale through cross stratification at a linguoid bedform crest type reach and large-scale (2-3 m thick) sets of gravel planar cross-stratification. The second bedform recognized is related to described macrodunes, and is comparable to large-scale antidunes, and produce tabular bodies with very subtle undulating structure. The third and perhaps more important is described as "gravel sheets" although they could be also low-relief gravel dunes developed during low-flow events, on top of the large-scale bedforms or directly over a flat gravelly bed. It is well known that bedforms produce the effect of delay averaged sediment velocity with respect to flow velocity, and thus we propose that this delay has an important geological effect as it creates a lag time between the onset of discharge increase and the time the channel bed reaches an equilibrium with the dominant flows.

The effect of changes in the transport efficiency of submarine slope systems in the resulting depositional architecture is already known. However, we introduce here the concept of lagging the coarsest-grained fractions, delayed by the fact they involve in bedform building which move at lower velocities of the flows and hence allow the system to pass along a stage in which flows are big and fast, but the bed is not in equilibrium with them and as a result, canyoning may occur. These changes in external conditions (flow discharge) is likely to occur as a result of changes of turbid water near the slope by fluvial action and hence it would be t result of the interplay of river discharge and eustacy.