Intrabasinal and Extrabasinal Turbidites: Origin and Distinctive Characteristics

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Abstract

After its original conception, turbidites were related to re-sedimentation processes in deep waters. Sediments initially stored in littoral/shallow marine environments were periodically transferred (or re-sedimented) into the inner basin by slope instability. Since these turbidites originate within the marine basin, the resulting sediment gravity flows are intrabasinal turbidites. More recently, an increasing number of evidences show that turbidites commonly originates from the direct discharge from rivers in flood. These turbidites result from relatively dense turbulent sediment suspensions entering the sea as hyperpycnal flows. Since these turbidites originate in the continent, they are extrabasinal turbidites. The deposits of intrabasinal and extrabasinal turbidites have diagnostic features allowing a clear differentiation of them. Intrabasinal turbidites are dominated by surge-like flows, and commonly initiate from a cohesive debris flow that progressively dilutes and transform into a granular and finally a turbulent flow. Since intertidal water is ambient water, lofting is not possible. Additionally the dynamics at flow head washes the turbulent flow from light materials resulting in normally graded beds without plant remains. On the contrary, extrabasinal turbidites are fully turbulent flows with interstitial freshwater, driven by a relatively dense and sustained river discharge. Depending on the grain-size of suspended materials, the resulting hyperpycnal flow can be muddy or sandy. Sandy hyperpycnal flows also can carry bedload resulting in sandy to gravel composite beds with sharp to gradual internal facies changes and plant debris, laterally associated with lofting rhythmites. Lofting occurs because flow density reversal due to the buoyant effect of freshwater when a waning turbulent flow loses part of the sandy suspended load. On the contrary, muddy hyperpycnal flows are loaded by a turbulent suspension of silt and clay. Since the concentration of silt and clay don't decrease with flow velocity, muddy hyperpycnal flows will be not affected by lofting and the flow will remain attached to the sea bottom until its deposition. The last characteristics commonly result in cm-thick graded shales disposed over an erosive base with dispersed plant debris and displaced marine microfossils. It is interpreted that most of the shales of the Jurassic Los Molles and Vaca Muerta formations in the Neuquen Basin (Argentina) were accumulated in this way.