# Submarine topographic control on the distribution of supercritical-flow deposits: insights from the Middle Eocene deep-marine system, Ainsa-Jaca basins, Spanish Pyrenees

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Supercritical flows and their deposits have become central to the understanding of the architecture of deep-marine systems. Research has focused on the recognition criteria of supercritical-flow deposits (SFDs) using numerical modelling, flume-tank experiments, direct observations on active deep-marine systems and more recently from observations of ancient-deep-marine systems.

Here we link facies associations with SFDs observed in proximal submarine canyon-channel systems in the Middle Eocene Ainsa Basin, and in correlative lobes in the Jaca Basin. Two categories of supercritical-flow bedforms are defined: (i) erosional coarse-grained bedforms such as large- and small-scale cyclic-step deposits, and (ii) depositional fine-grained bedforms such as stable and unstable antidune and upper-plane bed deposits.

Quantitative analysis of SFD distribution shows a decrease from proximal-canyon to distal-lobe environments linked with a decrease in flow strength and velocity. Two surprising trends in the proportion of SFDs are observed: (i) the highest proportion of SFDs are in the lower-slope environment of the Ainsa Basin, and (ii) the proportion of SFDs from proximal to distal lobe environments shows no systematic changes.

From an interpretation of SFD distribution, three parameters are identified as playing a role on flow criticality: (i) flow confinement, (ii) seafloor gradient and (iii) basin geometry. We also recognize that the highest proportion of fine-grained sediments occurs with the highest abundance of SFDs. This relationship is linked to the preservation potential of SFDs and the amount of sediment bypass. Erosional, coarse-grained supercritical-flow bedforms are located in relatively confined settings with steep slopes and greater sediment bypass, whereas depositional fine-grained supercritical-flow bedforms occur in unconfined settings with lower seafloor gradients and good preservation potential.

We show that there is a trade-off between seafloor topography (confinement and gradient) and preservation potential, both playing a role in the formation and distribution of SFDs in deep-marine systems, and therefore, on the architecture of submarine fans.

Keywords: Supercritical-flow deposits, Seafloor topography, deep-marine system, flow confinement