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Simulating the 1999 turbidity current in Capbreton canyon (French Atlantic Coast) using a Cellular Automata model

T. Salles (1,2), **T. Mulder** (2), M. Gaudin (2), S. Lopez (1), M.C. Cacas (1) and P. Cirac (2).

(1) Institut Français du Pétrole, Département. de Géologie, 4 avenue de Bois Préau, 92852 Rueil Malmaison Cedex, France

(2) Université Bordeaux 1, UMR CNRS 5805 EPOC, avenue des Facultés, 33405 Talence Cedex, France. t.mulder@epoc.u-bordeaux1.fr

A numerical model has been developed for the simulation of density currents using several grain size fractions over a complex three dimensional submarine topography. The model is based on the Cellular Automata (CA) concept. CA represents an original approach for the modelling of dynamical systems. The aim of the model is to predict sediment erosion, transport and deposition in a channel during a single flow event or a series of flows. For CA simulation purposes, turbidity currents are represented as a dynamical system subdivided into elementary parts, whose state evolves as a consequence of local interactions and internal transformations within a spatial and temporal discrete domain. The model is developed for unsteady, two-dimensional, depth-averaged particle-laden turbulent underflows driven by gravity, acting on density gradients created by non-uniform and non-cohesive sediments. In particular, the model for flow motion is dynamically coupled to the sedimentary environment through a bed-sediment conservation equation.

The model is applied to a field-observed event, the December 1999 turbidity current in Capbreton canyon. This storm-induced turbidity current has been simulated using three grain-size fractions and using the high-resolution bathymetry of the canyon. The deposition is calibrated using three interface core that sampled the turbidite deposited during this event. The model well predicts the longitudinal evolution of the turbulent surge, the height of erosion along the canyon flanks and in the talweg, and the location

of deposition along the talweg sides and on the sedimentary terraces. It confirms that terraces act as confined levees. It shows the importance of sidewall erosion for particle supply during such an event. It clearly shows that the classical fining-up (Bouma) sequence is not deposited steadily. In this case, it results of several phases (pulses) of erosion and deposition explaining the presence of frequent intrabed erosional or sharp contacts within the sequence and the lack of sedimentary facies.