Geophysical Research Abstracts
Vol. 17, EGU2015-7279, 2015
EGU General Assembly 2015

Supercritical strata in Lower Paleozoic fluvial rocks: a super critical link to upper flow regime processes and preservation in nature

David Lowe and Bill Arnott

Department of Earth Sciences, University of Ottawa, Ottawa, Ontario, Canada K1N 6N5 (dlowe051@uottawa.ca)

Recent experimental work has much improved our understanding of the lithological attributes of open-channel supercritical flow deposits, namely those formed by antidunes, chutes-and-pools and cyclic steps. However their limited documentation in the ancient sedimentary record brings into question details about their geological preservation.

Antidune, chute-and-pool and cyclic step deposits are well developed in sandy ephemeral fluvial deposits of the Upper Cambrian – Lower Ordovician Potsdam Group in the Ottawa Embayment of eastern North America. These high energy fluvial strata form dm- to a few m-thick units intercalated within thick, areally expansive successions of sheet sandstones consisting mostly of wind ripple and adhesion stratification with common deflation lags. Collectively these strata record deposition in a semi-arid environment in which rare, episodic high-energy fluvial events accounted for most of the influx of sediment from upland sources. Following deposition, however, extensive aeolian processes reworked the sediment pile, and hence modified profoundly the preserved stratigraphic record.

Antidune deposits occur as 0.2 – 1.6 m thick cosets made up of 2 – 15 cm thick lenticular sets of low angle ($\leq 20^o$) cross-stratified, medium- to coarse-grained sandstone bounded by low-angle ($5 – 15^o$) concave-upward scours and, in many cases, capped by low angle ($10 – 15^o$) convex-upwards symmetrical formsets. Chute-and-pool deposits form single sets, 5 – 55 cm thick and 0.6 – 6 m wide, with scoured bases and low to high angle ($5 – 25^o$) sigmoidal cross-strata consisting of medium- to coarse-grained sandstone. Cyclic step deposits consist of trough cross-stratified sets, 20 cm – 1.6 m thick, 2.5 – 12 m long and 7 – 35 m wide, typically forming trains that laterally are erosively juxtaposed at regularly-spaced intervals. They are composed of medium- to coarse-grained sandstone with concave-up, moderate to high angle ($15 – 35^o$) cross-strata with tangential bases that conform to the shape of the basal bounding surface of the set. Antidune and cyclic step deposits are common and fill 0.4 – 1.8 m deep channels, which then are generally overlain by extensive (>1 km) aeolian deflation surfaces. Chute-and-pool strata, however, are rare and only occur as isolated scour-filling sets within unconfined floodplain deposits. Nowhere in outcrop do different kinds of supercritical bedform deposits interfinger or appear related to the same flow event, suggesting that individual packages of supercritical strata were deposited by discreet, rapidly waning flows with little time for incremental growth or deposition under changing flow conditions.

The stratal characteristics and geometries of channel-filling antidune and cyclic step cosets in the Potsdam are similar to those produced in steady experimental flows with high rates of aggradation. Similar conditions in the Potsdam were probably attained because the flows were channelized, which also caused the freshly deposited sediment to lie beneath the water table, and hence beneath the effects of extensive post-flood aeolian deflation. Conversely, scour-filling chute-and-pool deposits formed on the floodplain where highly unsteady, erosive and rapidly waning unconfined flows formed isolated, partly-filled, erosively-based, ephemeral structures. Moreover, being formed on the surface of the floodplain subjected these deposits to extensive post-depositional reworking, and as a consequence caused them to be poorly preserved.