FLUVIAL SEDIMENT ACCOMODATION AND MESOSCALE ARCHITECTURE—SOME NEGLECTED PERSPECTIVES. M. J. Wilkinson, Jacobs Engineering, NASA–Johnson Space Center, 2224 Bay Area Blvd., Houston TX 77058, USA. justin.wilkinson-1@nasa.gov.

Introduction: Common assumptions in modeling martian fluvial sedimentation are that enclosed basins are a necessary constraint, with waterbodies such as lakes or seas within the basins. Two recent studies [1] reinforce the fact that these constraints are unnecessary for the accumulation of large fluvial sediment bodies on Earth. Fluvial deposition on a slope is the norm in terrestrial basins—requiring neither closed depressions nor waterbodies. The following terrestrial perspectives probably apply on Mars.

Fluvial sediment accommodation: Where other controls are lacking, accommodation for fluvial sediment accumulation is controlled in the longer term by the slope of stream profiles. Profiles tend towards a smooth concave parabolic form, beneath which fluvial deposition takes place—i.e. under sloping stream profiles, and in locations where basin topography lies at altitudes lower than the profile (Fig. 1). The low-angle profiles of larger rivers project 100s km into lowland basins [1]. The associated sediment bodies in such basins, unconfined by valley walls, consequently cover very large areas (e.g. the Pilcomayo R. cone measures 210,000 km² [2]). Further, a distal confining wall—as in an enclosed basin—is not a necessary constraint. In hyperarid settings, accommodation can be increased locally since lower reaches of many desert rivers are convex up (steepening through loss of discharge [3]—dashed line, Fig. 1)—which implies a significant accommodation volume in an unconfined lowland.

Mesoscale architecture of fluvial sediment bodies in unconfined lowlands: Recent studies suggest that fluvial basin fills in unconfined settings are partial cones of low slope, and that large conical sediment bodies, still poorly recognized, are “the norm” in fluvially filled basins [1]. Larger basins are characterised by larger cones (100s of km long)—and are thus probably appropriate analogs for Mars. Such features are mesoscale (Group 9) architectural elements in Miall’s hierarchy of fluvial bodies [4], intermediate in size between channel belts (Group 8) and “smaller basin fill complexes” (Group 10).

Mars: A survey of large cones (>100 km long) on Earth has revealed >150 such features. Perspectives from the study have allowed prediction of the location of a large relict cone (260 km, 85,000 km³)—unsuspected by geologists from either remotely sensed imagery or numerous well-studied boreholes [5].

These perspectives should assist in identifying analogs on Mars. Indeed, possible examples of large sediment cones are modern Amazonis Planitia (and prior stages in its history) [6], and the feature at the mouth of Maja Valles. Large sediment cones have been suggested as loci of hydrous environments on Mars, based on a distal-cone aquifer in the Kalahari Desert [5].

Mesoscale fluvial cones, deposited on a slope, provide a model for fluvial deposition on larger martian plains—a parsimonious alternative without requirements for enclosed basins or waterbodies.