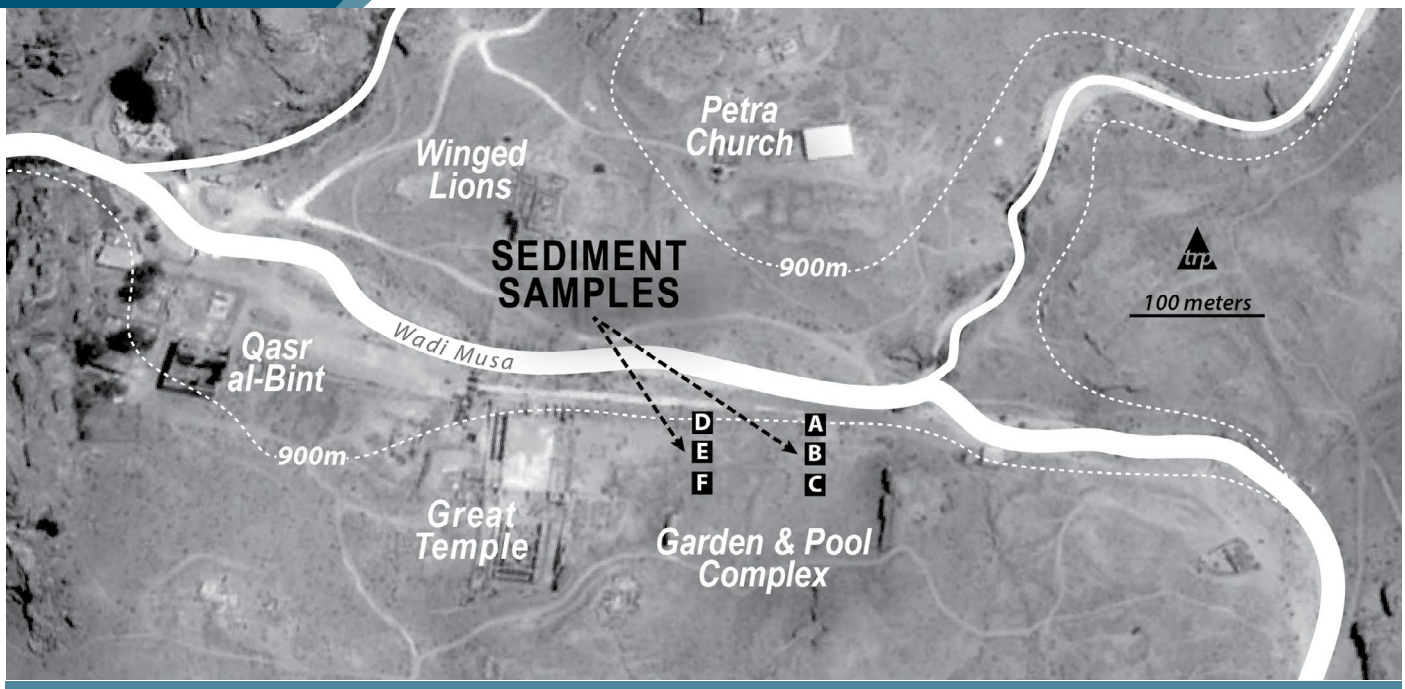

Fig. 83. Orthographic image of Petra's city center indicating some primary structures and the two collections transects away from the terrace separating Wadi Musa and the Colonnaded Street, from the Great Temple and the Garden-Pool Complex

PETRA: COLONNADED STREET FLOOD DEPOSIT ANALYSIS

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Although deserts are a result of low precipitation, they can sustain seasonal or episodic torrential flooding. Prior research revealed that Petra's city center was devastated in major flood(s) during the 4th and 5th centuries A.D. (Paradise 2011). Evidence supporting Petra's historic flooding included oversized meanders, perched flood sediments, current underfit channels and terraces, and missing street pavers suggesting mega-flood scale discharge. However, one of the strongest indications of palaeo-flooding can be demonstrated through distinct patterns of sediment distribution. As floodwater rises above its channel, high energy water mobilizes larger particles (boulders, pebbles, gravel) while slower energy water can only move finer sediments (sand, silt, and clay). As floodwaters rush downstream, they also rise and flow laterally creating distal environments. Within Petra's civic center, its primary road runs along the main watercourse, Wadi Musa, where boulders, pebbles, and gravel are commonly entrained, transported, and deposited along the wadi flanks during episodic flooding. During infrequent flood events, sediment-filled water actually deposits finer particles above the channel banks and terraces. It is this distribution of fine particles that is indicative of lateral, distal environments that flank extensive flooding (Leopold et al. 2012).

Since research indicates that sediment and particle distribution from overbank flooding displays distinctive patterns, a sampling scheme was created to analyze grain size distribution above the wadi bank where catastrophic flooding has been speculated. Samples of surface sediments were collected above the bank of Wadi Musa across the terrace that separates the wadi channel from the upper floodplain below Petra's flanking rocky outcrops. Six one-kilogram samples were collected during summer 2016 across the south side of the terrace that flanks Wadi Musa above the Colonnaded Street. Three samples were collected at

roughly five meter intervals in two transects, orthogonal from the terrace ridge above the wadi toward the Garden and Pool Complex and the Great Temple.

Pebbles and gravel were separated from sediment samples using 10 mm and 5 mm screens. Then, a vibrating stacked set of eight sieves ranging from #10 (2 mm) to #100 (0.15 mm) was utilized to separate and distinguish the various grain sizes along the transect (Fig. 83). Each sieved sample was weighed separately to compare the grain size component to the total sediment mass. The particle components were then converted to the percentage of grain size for the total mass at each collection site (A-F).

The results are significant in that they revealed an increasing fine grain component (fine sand, silt, clay) farthest from the wadi (Fig. 84). Conversely, gravel and coarse sand comprised 65–70% of the samples collected nearest the terrace edge (A, D) while only 30–35% of the largest grain sizes were found farthest from the terrace edge. In essence, fine sand, silt, and clay comprised more than 70% of the samples collected farthest from the terrace edge indicating the distal edge of a palaeo-floodplain (He and Walling 1998).

These findings confirm conventional palaeoflood studies where high-energy environments (channel bank) entrain, transport, and deposit larger "grain sizes" (pebbles, gravel), while low-energy environments (distal) transport and deposit finer particles (sand, silt, clay). Distal areas of floodplains are characterized by larger components of finely-grained particles—the case along the channel terraces in Petra. This analysis confirms prior research that Petra's city center may have been inundated and razed by catastrophic flooding in the 4th and 5th centuries. A pattern of fine particles increasing away from the wadi channel indicates a low-energy distal floodplain where lateral flooding (during a rare mega-flood) deposited the finest silt and clay particles high above the wadi and road, on the terrace of the Great Temple and the Garden and Pool Complex—indicating higher floodwaters than previously indicated.

REFERENCES:

He, Q. and D. E. Walling. 1998. "An investigation of the spatial variability of the grain size composition of floodplain sediments." *Hydrological Processes* 12(7): 1079–1094.

Leopold, L, M.G. Wolman, and J. Miller. 2012. *Fluvial Processes in Geomorphology*, Dover Earth Science Series.

Paradise, T.R. 2011. "Petra's Great Flood: evidence for a catastrophic flood in the 5th–6thCentury." *Annual of the Department of Antiquities of Jordan* 56: 143–58.

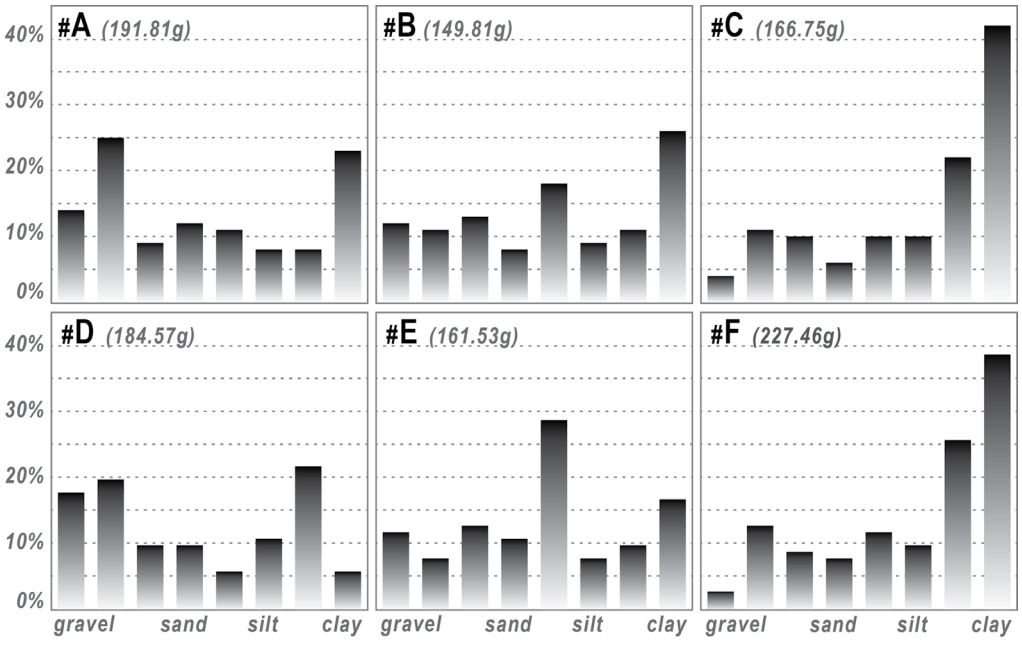

Fig. 84. These bar graphs illustrate the distribution of grain sizes from large (gravel) to fine (silt-clay) along the collection transect. The finer grain sizes were found to increase away from the wadi channel indicating a distal floodplain environment. This area of Petra above the Colonnaded Street—along the terrace that fronts the Great Temple and Pool-Garden Complex—was previously unidentified as a palaeo-floodplain.