A Grain Size Transect of Badwater Basin, Death Valley, CA

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1) Introduction:

Death Valley, CA is a well-known closed basin with a xeric environment. The Death Valley Fault Zone is a right lateral-moving fault in California. It runs from a connection with the Furnace Creek Fault Zone south to a junction with the Garlock Fault. Materials eroded from the bounding mountain chains are focused in the center of the basin. These sediments are transported by gravity, wind, and water with sporadic times of alluviation. On occasion, portions of the valley floor flood dissolving evaporite minerals which are later concentrated by evaporation. Other than these and rare episodes, the floor of Death Valley is covered in sediment and in some locations desiccation polygons. Analysis of the stratigraphy in Death Valley provides a wealth of information on paleoclimate in the region and shows both arid and wet conditions through time. Here, we characterize the modern grain size distributions of clastic materials at 10 sites using 40 samples within the Badwater Basin. The data set forms an east west transect across the center portion of the valley floor. Since evaporite minerals are abundant but their grain size results from crystallization conditions, we focus on the grain size of clastic minerals in the basin. We measured grain size of the clastic fraction after precipitates and organic matter was removed using a pretreatment procedure. Samples were disaggregated with sonication and a hexam-etaphosphate solution and grain size was measured using a Coulter LS 13 320. We focus on the grains sizes contained within desiccation polygons but also present additional samples for context. We examine multiple samples from different locations within individual desiccation polygons, from the edges and centers and compare these with samples along an 8-kilometer transect. The most abundant grain size range was between 0.4 to 150μm. The grain size distributions from multiple samples taken at each of the 10 sites were mostly consistent, suggesting that the grain sizes detected are repre-sentative of a given site location. In the transect, the average grain size across the playa is finest in the middle furthest from the alluvial fans. This research provides a snapshot of the grain sizes, environment, and spatial distribution of grain sizes on the modern playa floor which may help future interpretation of sedimentary records in the basin.

2) Prior and Current Research:

Sediment cores can be a powerful tool in pa-leo-environmental reconstruction. Lowenstein et al (1999) collected a core from Badwater Basin extending back 200ka. They found evidence of multiple shifts from lake to dry playa conditions. This study focuses on providing a context for modern analogue constraints on the grainsize distribution during times of dry playa conditions. Our aim is to evaluate grain size changes in different locations across the basin.

Hypotheses:

1) Fining grain size toward the center of the basin (function of transport distance)
2) Multimodal distribution along the margins of the lake and bimodal distributions towards the center (funcion of processes that transport sediment-Fan, fluvial transport, aeolian processes)
3) Surface morphology will correlate with grain size (e.g. mud flats vs desiccation polygons)

3) Study Site:

Badwater Basin (Fig. 1) is bounded by the Panamint Range on the west and the Amargosa range on the east. At the base of the mountain ranges are large faults which have enabled basin forma-tion. The basin contains large fan deposits which transition to the playa floor.

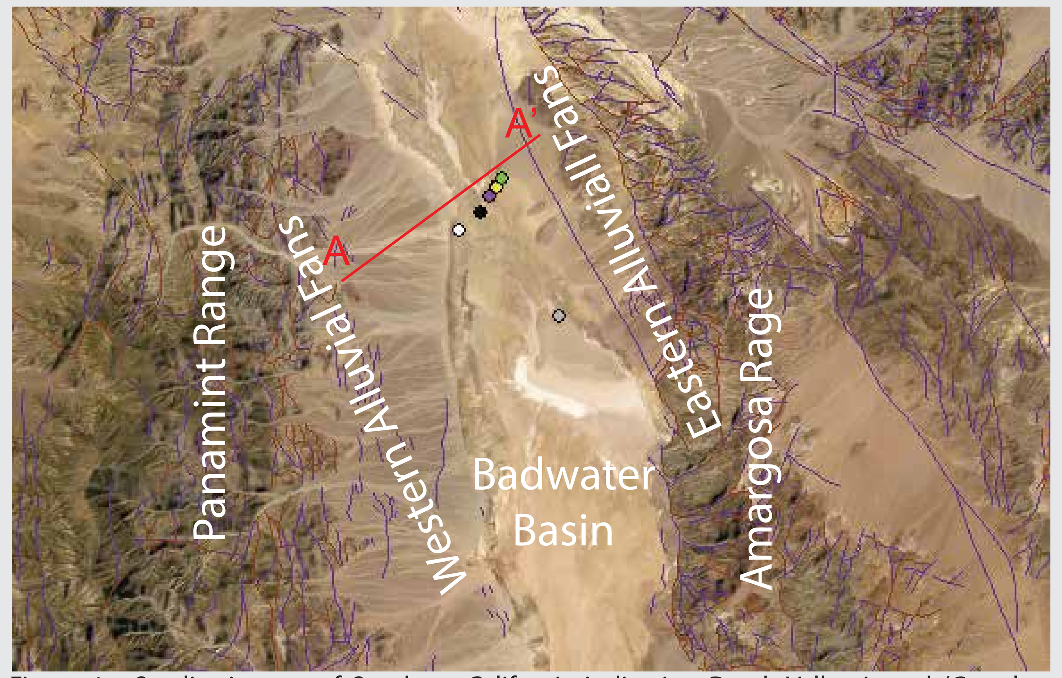

Figure 1a: Satelite imagry of Southern California indicating Death Valley in red (Google Earth, 2021). Figure 1b: Airphoto of Badwater Basin. Purple and brown line indicate faults (O'Mera 2014). Red line indicates transect. Colored dots indicate sample sites DVD1-10

4) Methods:

Field Sampling:

We selected 10 sites in transect across the Badwater Basin. 8 sites were part of a continuous 4 kilo-meter-long transect across the playa floor and two other sites were selected approximately 8 kilometers to the south to-wards the center of the basin. At each site, we documented the ground type and collected multiple samples.

Large desiccation polygons at site DVD9

Laboratory Methods:

We were interested in the grain size of the clastic materials, thus pretreatment was nec-essary to remove evaporite minerals. Treatment involved:

1) DI Water rinse
2) 5% acetic acid leech
3) 30% hydrogen peroxide leech
4) Disaggregation using hexametaphosphate
5) Grain sizes were measured using a Coulter LS 13 320 Particle Size Analyzer

Preparation of samples for grain size analysis

5) Results: Grain size data from a transect across Badwater Basin:

Surficial geologic map (Fig. 3) Representative landscape photographs of Badwater Basin (Fig. 4) Cross section of transect with sample sites indicated (Fig. 5) Grain Size distribution graphs and sample photos, (Fig. 6) Compartitive grainsize distribution analysis (Fig. 7).

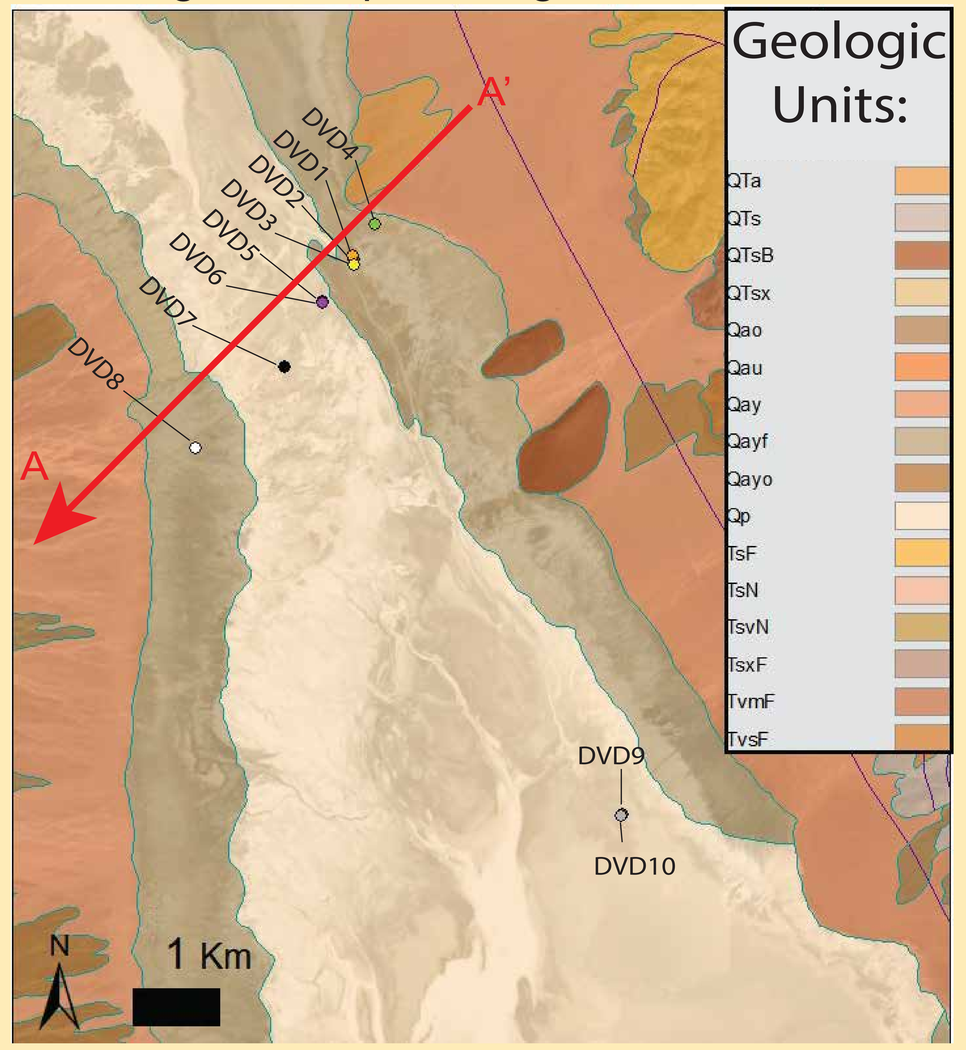

Figure 3: Surficial geologic map of Badwater Basin. Sample locations indicated. Samples collected from Young Alluvial Deposits and holocene playa deposits.

Figure 4: (Left) Overview of valley bottom. Light colored regions show areas of relatively young evaporite deposites. (Right) View of surface of Badwater Basin.

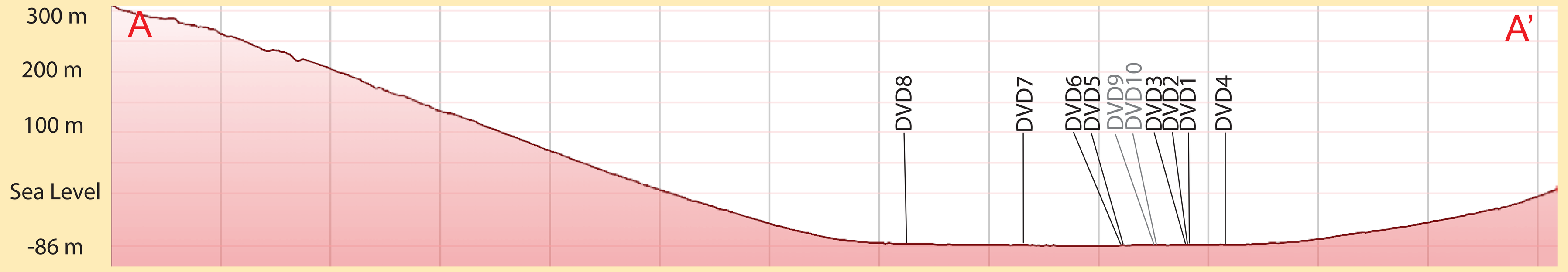

Figure 5: Topographic profile along the sampling transect from south west to north east showing the profile of the alluvial fans that contribute sediment to sites DVD1-8. Samples DVD 9 and 10 were extrapolated on to the transect based on relative position in the basin.

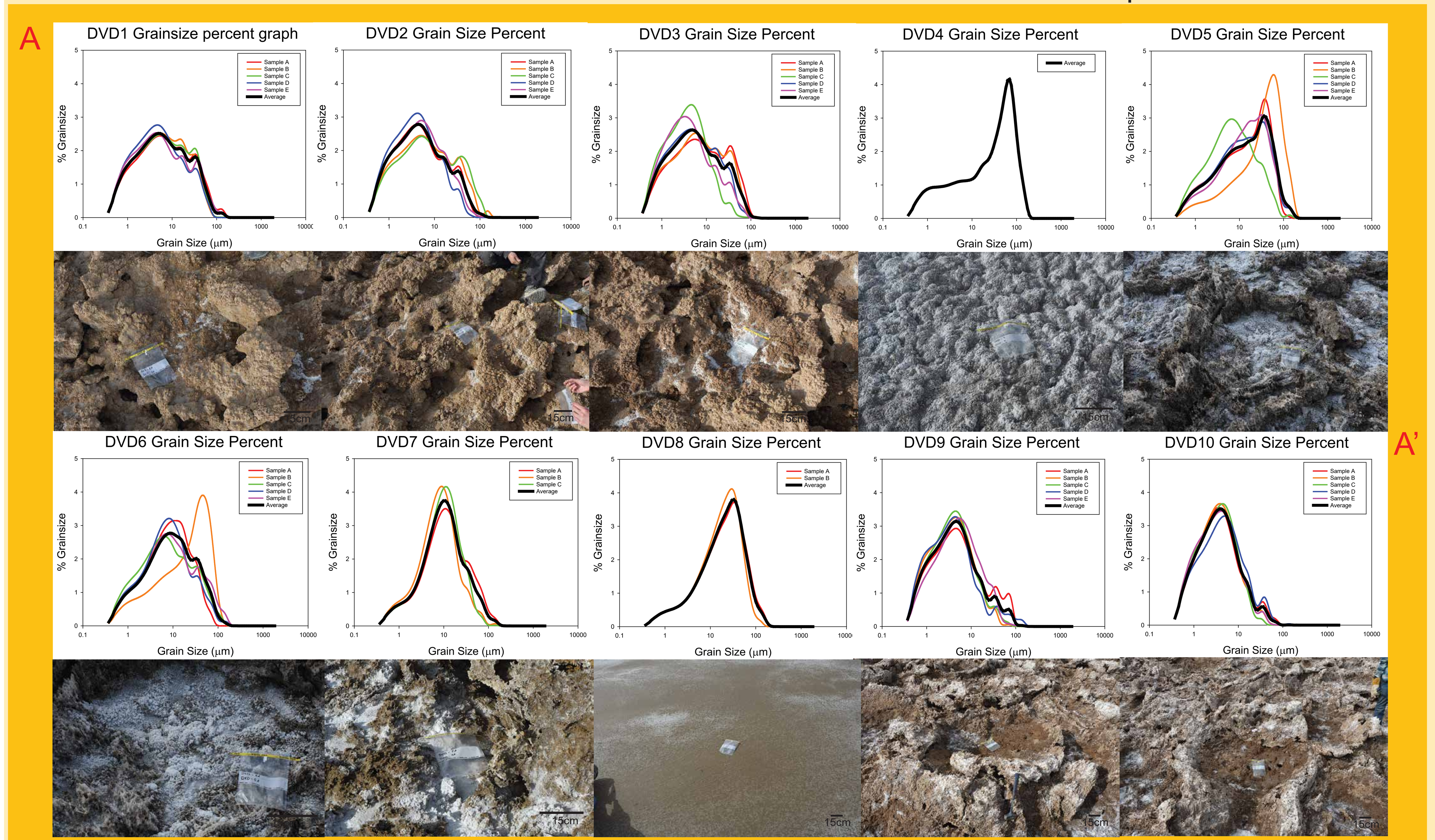

Figure 6: Grain Size Distribution plots and photographs from each sample site in Badwater Basin. The colored lines represent the grain size distribution of each sample collected and the black line represents the average grain size. DVD sites1, 2, 3, 4, and 8 are part of the Death Valley regional flow system and are young alluvial deposites (holocene). DVD sites 5, 6, 7, 9, and 10 are holocene playa deposits. DVD sites 9 and 10 represent well developed dessication polygons.

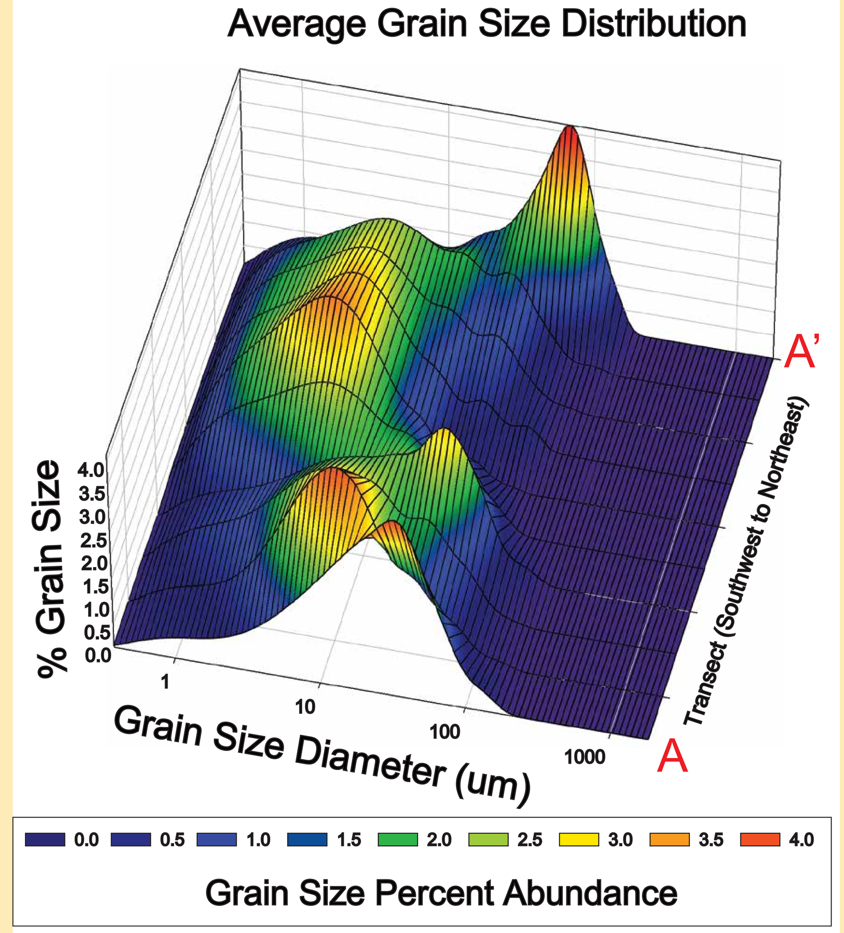

Figure 7: Grainsize distribution plot ar-ranged from west to east along the transect. Samples near the valley walls show coarser grain sizes and right skew distribution whereas the sam-ples near the center of the playa have finer grain sizes and a distribution closer to normal.

6) Discussion:

Mean grain size and grain size fractions (Fig. 8) changes across Badwater Basin.

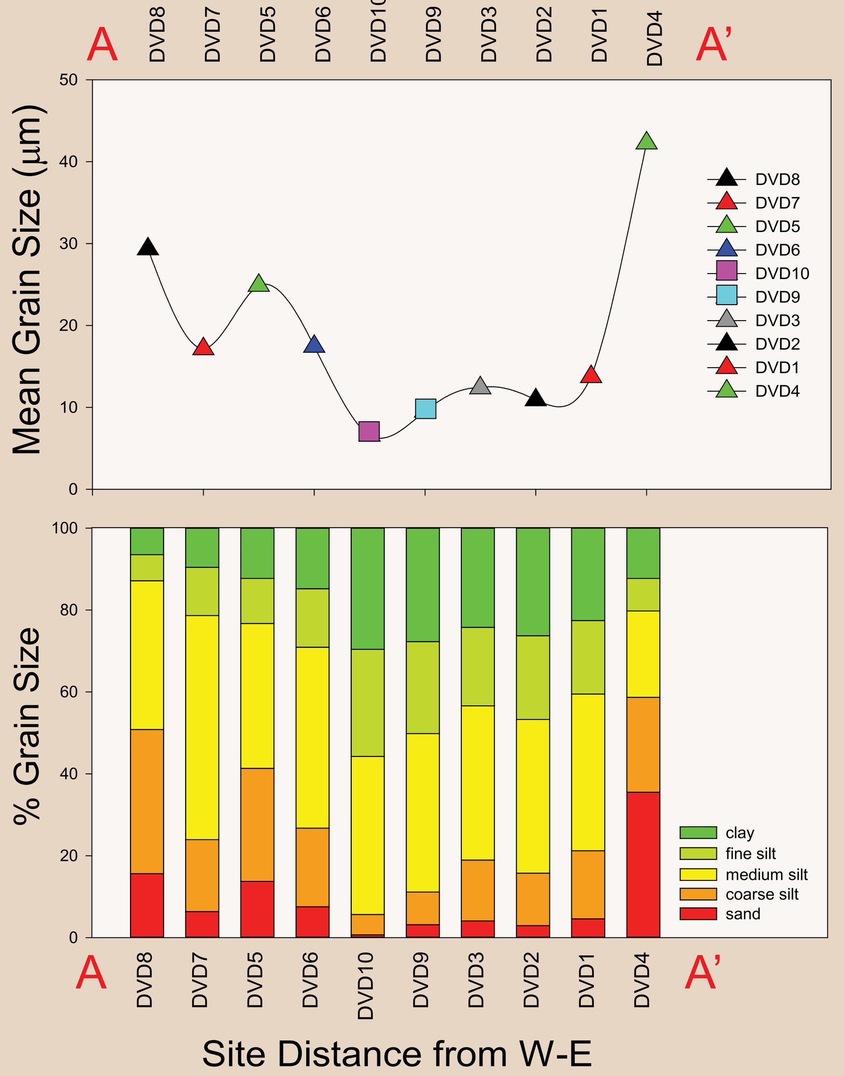

Figure 8: (Top) Average grain size across the playa. (Bottom) Grain size fractions across the playa from southwest to north-east. The average grain size on the periphery of the playa is coarser than the average in the middle. Sand and coarse silt fractions decrease toward the center and clay and fine silt fractions increase. Medium silt stays relatively constant. Thus, this fraction is not particularly diagnostic. Average grain size, grain size distribution (Fig. 7) and grain size fraction (Fig. 8) provide more in-formation about grain sorting across the playa.

7) Conclusions:

Our study shows:

1) At each site, individual samples from different locations had similar grain size distributions. This is particularly interesting at sites where different samples reflected different locations (top, edge and center) of desiccation polygons.

2) We observed a fining pattern towards the center of the basin (Fig. 8). The grain size distribution shape was very similar for the central sites (Fig. 6 and 7).

3) It is not clear if the fine sediments in the basin are primarily sorted by wind, fluvial transport or by sediment suspension during lake high stands. The materials are likely recycled. The consistency of the medium silt fraction is intriguing and suggests a consistent mecha-nism of delivery in relation to the other size fractions. Perhaps, this is representative of a local dust component. It is very likely that any grain size courser than sand is a product of fluvial transport.

8) Acknowledgements:

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9) Citaions:

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