APPLICATION OF GROUND-PENETRATING RADAR IN THE DEATH VALLEY FIELD SITE: INFLUENCE OF FERROMAGNETIC MINERALS ON THE PROPAGATION OF ELECTROMAGNETIC WAVES SEND OUT BY GPR

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Originally the study wanted to test the utility of ground-penetrating radar (GPR) in three dimensional imaging alluvial fans in the Death Valley. The test area was chosen due to its prominent alluvial fans flanking the mountain fronts. Lack of vegetation and easy accessibility of fan surfaces combined with coarse-grained sediments and deep groundwater levels seemed to fit perfect for applying the GPR on the sedimentary architecture. Expecting a deep penetration depth of the electromagnetic wave with an excellent signal, we measured shallow penetration depth with a low signal to noise ratio. Moreover we measured high inductivity effects on the cable linking the antennas and the processing unit. Aiming to understand the attenuation and scattering effects of the electromagnetic wave we conducted a GPR "reference" survey using different antennas ranging from 60 to 200 MHZ Although the overall signal to noise ratio was very low with "multiple reflectors", using higher frequencies the quality of the radargrams improved.

To verify the source of attenuation and scattering, sediment susceptibility was measured on different desert pavements, including the measurement of fines and a representative portion of different rock types, trying to consider the different catchments and their underlying lithologies. Measurements were taken on the western and eastern flank of the Death Valley. High susceptibility values of around 0.1 to 43 (normally values are around 0.01) showed in a clear way that there are abundant ferromagnetic minerals in all alluvial fan deposits.

Although it is known that the electromagnetic wave consists of an electric- and magnetic part, oscillating perpendicular towards each other, it is not described in literature that magnetic properties of the underlying sediment can influence the propagation of the electromagnetic wave. Due to high magnetic susceptibility values we propose, that the electromagnetic wave will be reflected and scattered at the surface and gain only shallow penetration depth. The higher the used GPR frequency, the higher was the inertia of the magnetic dipoles in the grains and thus the higher was the penetration depth.

Although the GPR was not able to image the deeper architecture of alluvial fans, it provided some insights into the filling history of the active channels where the transition from the most recent fluvial deposits and alluvial fan bedrock was mapped.