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Geophysical survey at Tell Barri (Syria)

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A geophysical survey at the archaeological site of Tell Barri (Northeasterm Syria) was carried out. The Tell (Arab word for "hill") is 32 m high with a whole covered area of 37 hectares.
The Tell, with its huge dimensions and with a great amount of pottery on the surface, is a precious area to study the regional history from IV mill. BC to Islamic and Medieval period.
The geophysical study consisted in magnetic and electromagnetic measurements in the lower town area. The aim of this survey was to provide evidence of the presence of buried archaeological structures around an already excavated area. The wall structures in the Tell Barri are made by backed or crude clay bricks.
The instrument used for the magnetic survey was an Overhauser-effect proton magnetometer (Gem GSM-19GF), in gradiometric configuration. The electromagnetic instrument used, Geonics Ltd. EM31, implements a Frequency Domain Electromagnetic Method (FDEM). It was used in vertical coils configuration, and this choice should grant a maximum theoretical investigation depth of about 6 m.
Before starting the measurements on a larger scale, we conducted a magnetic and EM test profile on some already excavated, outcropping, baked bricks walls. Results were encouraging, because clear and strong magnetic and EM anomalies were recorded over the outcropping walls. However, in the survey area these structures are covered by 3 to 4 meters of clay material and the increased sensors-structures distance will reduce the anomalies amplitude. Moreover, the cover material is disseminated with bricks, basalt blocks and ceramics, all of which have relevant magnetic properties. After magnetic surveying some 50 m side square areas, we verified that unfortunately their effect resulted to be dominant with respect to the deeper wall structures, degrading too much the signal-to-noise ratio. The processing and analysis of magnetic data is however currently underway and will determine decisions about further use of this method in future surveys.
These disturbances were much lower in the EM data, thus, these data were acquired in 7 squares having 50 m long sides, along profiles spaced 0.5 m. The acquisition rate, combined with the operator speed, resulted in an average sampling step of 0.2-0.25 m along each profile.
First, the quadrature and inphase data were interpolated at a regular step of 0.5 m and visualized in false colour maps representing the spatial variation of conductivity and magnetic susceptibility, respectively. Then, corrections for zig-zag effect and heading error were applied. In both maps many elongated anomalies are visible, often crossing each other perpendicularly and arranged with a meaningful orientation with respect to the topography. This suggest a possible archaeological meaning for these anomalies. Quadrature data were processed by AGC filter to obtain an amplitude-normalized map. Data were further processed with algorithms based on spatial derivatives that can define the position of the source bodies with higher definition. Some hypothesis about the meaning of these linear anomalies include the presence of an urbanization area, with edifices and roads. The orientation of many structures in directions parallel or perpendicular to the altitude isolines may also suggest the presence of ancient defensive structures. Thus, the main result of the geophysical investigation was to highlight that the urbanized area extent is wider than known before. The fine stratification of the archaeological remains at Tell Barri site represents a major difficulty to the interpretation. During the next mission some anomalies will be the target of excavations to improve our understanding of the conductivity pattern and its interpretation.