Near-Surface Geophysical Mapping of Williamson Creek Volcanic and Austin Chalk Outcrops in South Austin, Texas

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ABSTRACT

Geophysical surveys were conducted at the Williamson Creek site in south of Austin, Texas, to determine the structural relation of the Upper Cretaceous volcanic rocks (lava and tuff) with its associated Austin Chalk limestone. At this site, resistivity and magnetic methods were performed over the exposed volcanic and limestone rocks. Geophysical results indicate an excellent correlation between high magnetic, and low resistivity anomalies. Two-dimensional resistivity imaging data indicate a volcanic vent structure and dislocated sedimentary rocks. Blasted from the eruption, Austin Chalk blocks are observed throughout the volcanic matrix. The pseudo 3D resistivity data shows a steeply dipping funnel-shaped vent formation over the high magnetic anomaly (up to 3000 nT). Magnetic anomalies are consistent with a uniformly magnetized body, like a volcanic vent; and dimensions of the anomaly are consistent with eroded volcanic vents in other distributed volcanic fields in the USA. It should be noted that this is the first near-surface geophysical study that defines a volcanic vent and explores the internal structure of it.

Magnetic data has been integrated with resistivity data and geologic observations and subjected to 2.5D forward potential field modelling. Modelling has revealed a perfect fit with three magnetic zones: (1) the central part corresponds to the main magma feeder (vent); (2) the surrounding zone corresponds to undifferentiated interbedded tuffs and lavas; and (3) the low-magnetization zone. Geophysical results show that additional resistivity surveys, in conjunction with magnetic surveys, could offer useful information on the shallow volcanic plugs (serpentines), which are potential oil and gas traps in the state of Texas, and their adjacent sedimentary rocks. The procedures developed here may have applications in other areas with comparable geological conditions.

Saribudak, M., 2021, Near-surface geophysical mapping of Williamson Creek volcanic and Austin Chalk outcrops in South Austin, Texas: GeoGulf Transactions, v. 71, p. 499.

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