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TITLE: Telluric and Earth Currents, Lightning Strike Locations, and Natural Resource Exploration

AUTHORS (FIRST NAME, LAST NAME): H. R. Nelson1, Les R. Denham1, D. James Siebert1

INSTITUTIONS (ALL): 1. Dynamic Measurement LLC, Barker, TX, United States.

ABSTRACT BODY: Telluric currents are natural electric currents flowing in the Earth's crust and mantle. The boundary between the crust and the mantle is the Mohorovičić discontinuity, which is 20 to 90 km (12.4–55.9 mi), or an average of 35 km (21.7 mi), beneath the typical continent.

Telluric currents have been used by geophysicists to map subsurface structures, such as sedimentary basins, layered rocks, and faults since the 1950's using magnetotellurics. Telluric currents balance currents in the ionosphere, a shell of electrically charged atoms and molecules surrounding the earth from a height of about 50 km (31.1 mi) to more than 1,000 km (621.4 mi).

Lightning strikes balance telluric/ionosphere capacitance by bridging the lower atmosphere dielectric with static bursts creating about 350 million annual cloud-to-ground (CG) strikes. Most lightning comes from cumulonimbus clouds which generate lightning from the base at 1-2 km (0.6-1.2 miles) above the ground to the tops, up to 15 km (9.3 mi). Upper-atmospheric lightning, known as sprites, blue jets, and ELVES range in height from 20 km (12.4 mi) to 100 km (62.1 mi).

In many natural phenomena, events at boundaries generate the most information. For CG lightning, the boundary is the strike point, and attributes of the lightning stroke contain the information. While topography, certain trees, and infrastructure have an impact on where lightning strikes, the composite conductivity or resistivity of the rock matrix and cracks in this rock matrix appear to have more influence on where CG strikes occur and attributes like rise-time, peak current, and peak-to-zero time.

The strike skin depth is negligible relative to natural resource exploration depths. However, as described above, the telluric and ionospheres' and meteorological currents setting up lightning strikes greatly exceed typical exploration depths. Based on numerous lightning data analyses, we have come to the conclusion there are earth currents, which we call terralevis (shallow earth) currents, in the depth range of natural resource exploration, and which have a controlling impact on CG lightning strike locations and attributes. We present lightning analysis examples leading to this conclusion. In some ways, this work is an extension of Nikola Tesla's experiment at his Pike's Peak laboratory in 1889 when he confirmed the Earth itself could be used as an electrical conductor, and verified some of his suspicions regarding the conductivity of the ionosphere.

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Student Status: I am not a Student

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