# LiDAR and Its Use in the Identification of Faults, Fractures and Sub Surface Structures in Drift Covered Areas

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## Abstract

LiDAR (Light Detection and Ranging) is the scanning of the earth's surface with an airborne laser and the recording of the reflected scan. Individual laser pulses are projected upon the earth's surface with the individual pulse's reflection's intensity, trajectory and corresponding GPS positioning digitally recorded. For the purpose of this report we are only interested in the results of the bare earth or last return. LiDAR bare earth returns strip away all vegetation and culture to provide a stunningly clear digital image of the earth's surface and it is with these images of the surface we are able to locate buried faults, fractures and sub surface structures.

Very faint signatures of the upward propagation of geologic structures can be measured on the surface using LiDAR derived digital elevation models. Faults and fractures also have an upward propagation and a percentage can be traced on the surface using slope angle datasets. Slope angle terrain datasets are very precise and are proving to be an effective method of identifying sub surface faults and fractures on the surface of drift covered areas. We are seeing correlations between fracture controlled Ordovician Trenton/Black-River oil and gas fields In Indiana and Michigan with higher slope angles. Albion-Scipio and the Adrian fields of Michigan have very distinct slope angle signatures. Differential compaction of formations above Devonian reefs in southwest Indiana in some cases can be modeled on the surface using LiDAR derived digital elevation models, with the Hulman oil field in Vigo County, Indiana being a prime example.

We are just beginning to integrate LiDAR data with other exploration methods such as magnetics, gravity, 2D and 3D seismic. The digital nature of LiDAR makes it a good fit with the other exploration methods used in the industry today. Current LiDAR technology is advancing rapidly, multispectral arrays, remote controlled drones and less expensive more powerful cameras will soon be the norm. In the very near future, LiDAR derived digital elevation models and terrain datasets will be important tools to be used by explorers looking for new oil and gas reserves.

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