A Novel Airborne Remote Sensing Technology for Wide Area Frontier Exploration in Deserts

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A novel airborne remote sensing technology is proposed to detect in flight over wide areas with a high spatial resolution the presence of micro seeps on the ground. The technology uses a scanning airborne laser system (LIDAR) and special live bacteria and yeast cells which function as ultrasensitive biosensors for hydrocarbons. These cells are natural inhabitants of desert soils and very well adapted to harsh desert climates. They are genetically engineered to function as environmentally safe whole cell fluorescent biosensors sensitive for traces of light hydrocarbons (C1-C4). They can be easily spread over wide areas of interest using conventional crop duster planes equipped with precision flight management systems. Once settled on the ground the biosensors come in contact with traces of light hydrocarbons to which they react with the genetically enforced massive production of fluorescent proteins inside their cells. The massive production of fluorescent proteins works as a very powerful biological amplification of an otherwise weak chemical signal from a micro seep. If excited with pulsed laser light of the correct wavelength the fluorescent proteins inside the biosensors will emit red shifted fluorescent light of a specific wavelength. This process yields now a further amplified and long ranged optical signal - detectable from the air in full flight using a modified LIDAR capable to detect fluorescent light from biosensors. The sequence of excitation, detection and georeferencing of fluorescent light from biosensors is happening instantaneously requiring only a single pass of a search aircraft carrying the LIDAR. Simultaneously a Digital Elevation Model (DEM) of the surveyed area with a spatial resolution of 1 meter together with high resolution aerial RGB pictures are routinely produced by the LIDAR. Any finds of specific fluorescent light from biosensors are recorded and automatically integrated in the DEM together with colour coded intensities for the fluorescent light. DEMs depicting fluorescent light from biosensors can be expected to be easily visually interpretable by geologists without any further handling or manipulation of the data. All LIDAR data as well as the DEM data are processed and presented by simple office computers.

Light hydrocarbons rise directly up to the surface due to their small molecule size and driven mainly by buoyancy forces. Hot spots or extended areas with a fluorescent response from biosensors are therefore indicative of underlying deposits justifying further follow up using seismic. As the proposed technology is airborne it allows searching quickly large areas of unexplored land for even the slightest signs of hydrocarbons. This makes it an ideal tool for “first time ever” frontier exploration. As there is no need to put a foot on the ground the technology is very well suited to explore remote, rugged or dangerous environments. Using cold climate adapted biosensors exploration of arctic regions could also become a possibility. The technology is also expected to be particularly useful in exploring for stratigraphic traps and the mapping of sweet spots in fractured tight gas plays as they are known to show not up well on seismic.