“Using Drones for Exploration Geoscience – Will it really make a difference?”

This presentation was given at the monthly meeting of the Denver International Petroleum Society (DIPS) on March 13 at the Wynkoop Brewing Company by Ronald S. Bell, President of Operations at International Geophysical Services, LLC. Mr. Bell received his BS degree in applied physics from Michigan Technological University, and has over 35 years of geophysical industry experience in mineral, groundwater, and hydrocarbon exploration; environmental subsurface site characterization; and marketing and sales of geophysical software, instrumentation, and services.

Mr. Bell was performing a ground magnetic survey in Nevada at the end of 2013 and thinking “there has to be a better way”. In this pursuit, he has partnered with Johannes Stoll of Mobile Geophysical Technologies in Germany to advance the use of Unmanned Aerial Vehicles (UAVs) in geoscience. Mr. Bell and his colleagues have formed a company to manufacture geophysical acquisitions systems using lightweight fixed and rotary winged drones, and feels that a better description for drones would be airborne robots.

UAS by Aeroscout GmbH Switzerland

The following abstract was provided as pre-publicity for the talk:

“The recent announcement by the Federal Aviation Administration (FAA) regarding the issuance of regulations for operating drones or, more precisely, Unmanned Aerial Vehicles (UAVs) for commercial enterprise within the air space of the United States will, when enacted later this year, create a minor frenzy of activity in many market sectors. From filming motion pictures to monitoring crop growth to a myriad of other non-military applications, entrepreneurs and established companies are currently preparing to take advantage of a pent-up demand for Unmanned Aerial Systems (UAS) and payload components or as to simply offer services once the legality for commercial use has been established.

Will exploration geoscientists benefit from the application of UAV technologies? If so, where and how will they be used? What will the benefits be to exploration and development companies? What will it cost? Do UAVs represent a true paradigm shift in the manner the business of exploration geoscience is done or, like the "dot com bubble", will it be just be a pile of hyperbole with little of substance? At the end of the day, will the use of drones for exploration geoscience make a difference?"

Drones are already making an impact. NASA has photos demonstrating a magnetometer system being used in the early 2000s and there is also a system in use in Siberia. Drones have been used to collect geoscience data for 30 years. The USGS has stated that it will be using unmanned aircraft systems for geoscience purposes.

The FAA has three categories for unmanned aircraft systems: public use, civil use, and use by hobbyists. Collection of geoscience data by private firms is considered civil use.

What are the advantages of drones for data collection?

- Lower data point cost
- Improved productivity
- Higher definition
- Greater sensitivity
- Access to difficult and risky areas
- Generation of more data

How will drones be used? Mr. Bell suggested the use of a "swarm" of low altitude drones where multiple devices interact to acquire a wide scope of geoscience data to evaluate rock type, alteration, structure, moisture content, seeps, hydrocarbon emissions, elevation and other properties. He envisages these swarms downloading data to the Cloud where sophisticated algorithms could look for deeper relationships. Drones can be used everywhere except over densely populated areas and airports (or Texas and Deer Trail, Colorado where they are liable to be shot down).

Twenty-five percent of the FAA Certificates of Waiver or Authorization (COA) for flights at or below 200 feet have been issued to universities for public use. Very few people use them in the civil sector. The FAA issued rules for civil use on February 15, 2015, which had a comment period of 60 days and concerned small UAS (under 55 pounds) conducting non-recreational operations. The rules would limit flights to daylight and visual-line-of-sight operations. They also address height restrictions, operator certification, optional use of a visual observer, aircraft registration and marking, and operational limits. The maximum airspeed would be 100 mph and the maximum height would 500 feet. To fly above 500 feet would require the permission and the need to be in contact with the air traffic control system. The upper limit would then be 18,000 feet. An operator would have to be at least 17 years old, pass an aeronautical knowledge test, and obtain an FAA UAS operator certificate. Drones would not need an airworthiness certification, but would have to be registered.

The FAA did not address the use of autonomous drones as they could prove politically problematic. However autonomous operation is permitted under the control of an operator to allow manual control if a problem arises. Line of sight operation means that only relatively small blocks can be surveyed at one time.

Drones should be thought of as platforms for multiple channels of data acquisition. Mr. Bell's magnetometer sensors can acquire magnetic, visible light, multi-spectral, near infrared and thermal infrared data in one pass. Drones must be robust and field repairable, as they will crash. Access and weather conditions will have a significant effect on the profitability of drones. Mr. Bell discussed other applications for drones, including the use of a hydrocarbon sniffer where a low flying slow drone would have advantages. The range of geoscience applications has not been fully explored.

Mr. Bell discussed his prototype drone system called the "Sparrow". This UAV has a 6-foot wing span and weighs less than 5 kilograms. It has a top speed of 100 km/hr and uses an electric motor, which has less impact on the sensors than a gas engine. However, a larger gas powered UAV with a longer flight capability is in the construction phase. A UAV can collect a significant amount of data in 1 hour, at which point the battery can be replaced and it is ready to fly again. Typically in 1 day, a 1-1.5 km square block can be surveyed on a 25 meter line spacing at a height of 30 meters.

Mr. Bell showed a magnetic survey of a maar volcano in Germany that had been prepared partly using an ultra-light and partly with a drone. The drone showed the ability to make a detailed survey. He answered a question from an audience member by saying that gravity surveys by drone would not be feasible for a while. Magnetic surveys by drone can be done at 20% of the cost of conventional ground surveys. High resolution surveys can be done at 50% of this cost. Mr. Bell then showed a surrogate UAV magnetic survey over the Teapot Dome in the Powder River Basin of Wyoming using the data from a helicopter high resolution magnetic survey. This survey identified 90% of the known wells in the field. The cost for the high resolution conventional survey would be $125-150/km, while a drone would cost $50-75/km.

An audience member asked about the regulations for using drones in other countries. Rules are already in place in Europe and permission is usually given within a couple of days. In reply to another question, Mr. Bell said that helicopters were best for high altitude surveys. The application of a swarm of drones to deploy geophones was discussed. These would make "juggies" obsolete. Mr. Bell also mentioned that he had recently heard of a local individual offering his service on the internet as a qualified drone operator.