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## **Newly Adopted and Combined Helicopter-borne, Ground-based and Laboratory Methods for Mineral Exploration**

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The Federal Institute for Geosciences and Natural Resources (Bundesanstalt für Geowissenschaften und Rohstoffe - BGR) actively promotes and develops new technologies and methods for mineral exploration within a number of scientific-technical projects. One of the major aims of BGR is to combine different technologies and methods in innovative ways, to take advantage of the technical infrastructures inside BGR and to join forces with exterior partners with highly valued expertise in mineral exploration and according technical fields.

BGR and partners currently develop new helicopter-borne systems for mineral exploration. Within the project "Deep Electromagnetic Sounding for Mineral Resources" (DESMEX) funded by the German Federal Ministry for Education and Research (BMBF) two semi-airborne systems are being designed, based on the common method of Audio-Frequency-Magnetics (AFMAG) but realised with firstly common magnetotelluric coil systems and secondly with Superconducting-Quantum-Interference-Devices (SQUIDS) both using ground-based transmitters. The design and production of the airborne sensing systems is being currently worked on. First field tests have been performed using conventional magnetotellurics and helicopter-borne frequency electromagnetics. The goal is to reach investigation depths of about 1 km. Standard geophysical data like gravity and magnetics will be used and if necessary acquired to complement the given data.

In order to cover shallower sources of mineral deposits, another combination of systems, developed within the BGR-project HYPGEO, will be used in airborne field surveys. In this case, the helicopter will be equipped with hyperspectral and near-infrared camera systems, optionally a standard photogrammetric camera system, a gamma-ray spectrometer and a laser scanner. All data sets will be combined to get the best possible picture of a near surface mineral deposit, especially the gamma-ray and hyperspectral data. In order to be able to combine high resolution surface and subsurface structures, it is planned to perform additional flights using an airborne SQUID-based gradiometer system over an extended flight region.

For proper data inversion and interpretations rock samples are taken within the survey area and investigated in laboratories for their mineral content and structure, their petrophysical characteristics and their optical parameters. A special focus is set on Spectral-Induced-Polarisation (SIP) measurements that have been successfully adopted within the project ROBEHA, also funded by BMBF, which will be further adopted to complex mineralogical samples.

