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# UAS aeromagnetic survey for mineral exploration using a fluxgate triaxial magnetometer.

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Unmanned aerial systems (UASs) for aeromagnetic surveying are currently an advantageous and suitable alternative for a large variety of geophysical applications, such as mineral exploration. UASs equipped with lightweight fluxgate magnetometers can rapidly provide high resolution magnetic data under conditions where traditional surveys cannot operate safely. Furthermore, UAS-borne magnetic acquisition offer a new mapping scale to overcome the gap between terrestrial and manned airborne surveys in a cost-effective way. However, there are several sources of magnetic interferences that compromise the measurements of the Earth′s magnetic field, affecting the validity of observations and causing the development of unreliable maps. We address magnetic interference at the initial stages of survey planning and later on during processing. Fluxgate triaxial magnetometers can simultaneously measure the three components of the geomagnetic field but the sensor must be oriented and the heading of the aircraft plays an important role. To characterize the heading error it was essential to perform a compensation test including the possible flight directions before or after survey acquisition. To best adjust to the specific conditions of this case study, a processing tool was designed and programmed to compute suitable corrections and attenuate magnetic interferences. The three main corrections applied to the data included the removal of temporal variations, maneuvering noise and heading errors.

To test the potential of UAS for mineral exploration we selected a former mine in Otanmäki, Finland, as study site. To explore the contribution of low altitude UAS flights to characterize and improve the detection of geological structures, the study area was surveyed at three different heights: 60 m, 40 m and 15 m. For validation purposes, previous aeromagnetic studies in the area were employed, among them a ground magnetic survey. With regards to the efficiency of the UASs for aeromagnetic surveying it is worth mentioning that none of the flights lasted more than 15 minutes. The validation revealed that the total magnetic field maps consistently delineate the iron-ilmenite-magnetite deposits that enclose the test area. As expected, the superior spatial resolution was reached by the 15 m flight survey. Corrections played an important role during data processing. Nevertheless magnetic interference by heading errors was crucial for the reliability of this study. Our results suggest that after applying the pertinent magnetic compensations, UAS aeromagnetic surveys constitute a robust tool for mineral exploration.