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Title: **The hunt for mineral resources with quantum magnetometers**

Authors: Ronny Stolz[1,2], Markus Schiffler[1], Michael Becken[3], Anneke Thiede[3], Michael Schneider[4], Glenn Chubak[5], Ockert Terblanche[6]

Affiliations:

1 Dept. Quantum Systems, Leibniz Institute of Photonic Technology, Albert-Einstein-Str. 9, D-07745 Jena, Germany

2 Advanced Electromagnetics Group, Technische Universitaet Ilmenau, Helmholtzplatz 2, D- 98684 Ilmenau

3 Institute of Geophysics, University of Münster, Corrensstr. 24, D-48149 Münster, Germany

4 supracon AG, An der Lehmgrube 11, D-07751 Jena, Germany

5 DIAS Geophysical Ltd., 2131 Airport Drive, Saskatoon, SK, Canada, S7L 7E1

6 AngloGold Ashanti, 140 St Georges Terrace, Perth, Western Australia, 6010

Abstract Quantum sensing provides advanced technologies which significantly improves sensitivity and accuracy for sensing changes of motion, gravity, electric and magnetic field. Therein, quantum sensors for the detection of magnetic fields, so-called quantum magnetometers, are one of the most promising technological realizations.

In this work, we firstly will provide an overview on methods in geophysical exploration. There are various methods in exploration which would benefit from vastly improved magnetic field sensing technologies.

Then attention will be paid to state-of-the-art quantum magnetometers usable for this purpose. We will introduce recent developments on Superconducting Quantum Interference Devices, so called SQUID, based sensors and optically pumped magnetometers, so-called OPMs, as specific implementations of a quantum magnetometer.

These sensors have already today impact in mineral exploration. We will introduce some SQUID instrument implementations, related field operation demonstrations and case studies. For instance, airborne vector magnetometer devices with ultra-low noise of < 10 $fT/Hz^{1/2}$ and ultra-high dynamic range of real > 32 bit as well as a full tensor magnetic gradiometer with ultra-low gradient noise of < 100 $fT/(m \times Hz^{1/2})$ were already realized. Successful case studies will be presented and discussed.

Ground-based receivers for the transient electromagnetic method are already a mature technology being in commercial use for more than a decade. These quantum magnetometers led to a number of discoveries of conductive ore bodies. Also, a related case study will be presented.

Since there exist expectations about their use in geophysics, this work will provide a brief overview on the various developing quantum technologies and their individual state of the art for implementing quantum magnetometers.

Finally, future prospects of using quantum magnetometers in geophysical exploration and other applications will be discussed.

Keywords: Mineral exploration, Magnetics, Electromagnetic methods, Magnetic method, Quantum sensors, SQUID, OPM