Tropical soils impede landmine detection

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Use of a metal detector is the most common technique when searching for landmines, which litter the soil in approximately 90 countries around the world. Many of these countries are located in the tropics where intensively weathered soils are prevalent. These tropical soils have certain properties that can limit the performance of metal detectors due to soil magnetic susceptibility. This problem is enhanced by the spread of minimum-metal mines.

Magnetic properties of soils are caused by ferrimagnetic minerals, such as magnetite and maghemite. The negative effects can result in a reduction of detector sensitivity or cause false alarms. To overcome these problems, the metal detectors have been continuously re-hauled over the years but only now has the geoscientific research of the soil been taken into account. The knowledge of soil magnetic properties may allow detectors to be adapted to meet the local conditions.

Geoscientists at the Leibniz Institute for Applied Geosciences and the Federal Institute for Geosciences and Natural Resources in Hannover, Germany conducted a study on the magnetic susceptibility of tropical soils using the soil archive of the Federal Agency. The magnetic susceptibility of more than 500 soil samples from the entire tropical belt was analyzed with the goal of classifying their impact on landmine detection. The research was funded by the German Federal Ministry of Education and Research and was published in the January-February 2008 issue of the *Soil Science Society of America Journal*.

The study revealed that the problem of soil influence can occur quite

frequently. More than one-third of the measured soil samples may generate severe or very severe limitations when using metal detectors. Soils were grouped according to their parent rocks. On average susceptibility of soils with basaltic origin were higher than those of other origin. However, the variability within the different groups is high. This provides evidence that besides origin additional influences on soil susceptibility such as soil development are likely to exist.

The significance of the study is highlighted by a statement of Holger Preetz who conducted the study: “We are very lucky that such a large number of soil samples were available from the soil archive. This allowed us to investigate the impact of weathering and rock type on soil susceptibility simultaneously. We found a clear indication for a strong influence of soil development on the occurrence of high susceptibilities. Based on these results we are able to provide a classification scheme for the prediction of detector performance. This is of great interest for the de-mining community. During the planning phase of a de-mining mission the classification of magnetic soil properties can be done by using easily available geoscientific information.”

The study provides a solid base for further research. In an upcoming investigation we plan to clarify the question whether residual enrichment or neoformation of magnetic minerals is the dominant processes for increasing soil susceptibility during soil development. These results will provide insights whether it is more reasonable to use a soil map or a geological map or both for predicting susceptibility. In addition, the research looks into the characteristics of the frequency of the soil magnetic susceptibility which also affects detector performance and is therefore of great interest to the de-mining community.

Source: Soil Science Society of America