# TERRA Portable X-ray Diffraction (XRD) Analyzer: an Aid to Geological Interpretation in the Core Shack

**By Will Brownscombe, the Natural History Museum, London**

Logging drill core is one of the main activities that a geologist will do during his or her career. Even the most experienced geologist can be confused by the identification of ambiguous or fine-grained minerals. Too often, a geologist logging core will not be able to validate mineral observations without using costly and time-consuming thin section preparations. To help with this problem Olympus designed the TERRA portable X-ray diffraction (XRD) analyzer for testing mineral identifications in situ leading to more accurate geological logging. The ability to identify mineral composition in the field provides vital information to understand the geological system.

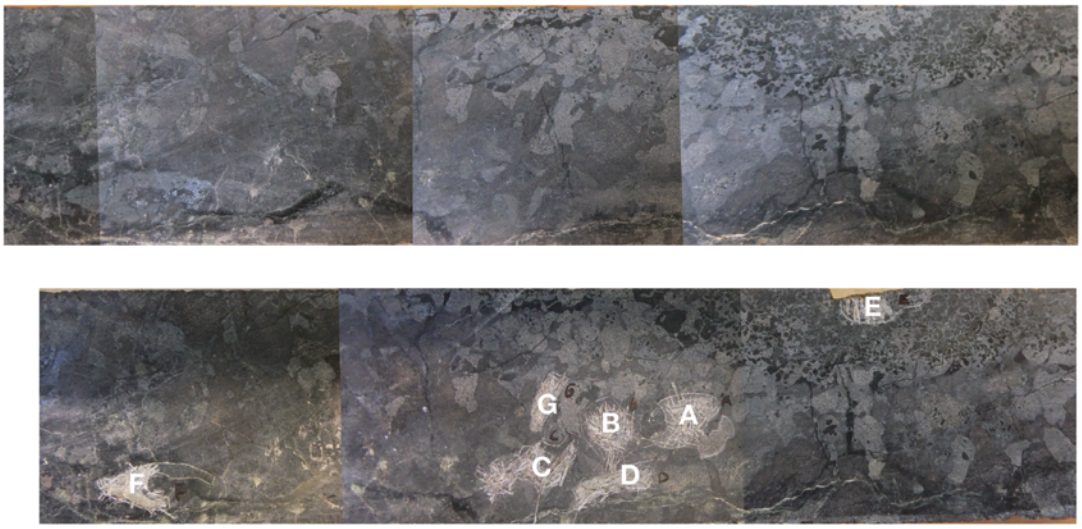
The Natural History Museum geological consultancy service assists mining companies with geological interpretations. Below, Will Brownscombe discusses two examples of how the TERRA analyzer was used by geologists to make mineral identifications in the field. The results show that the TERRA XRD provides accurate, repeatable, and immediate mineralogical analyses.

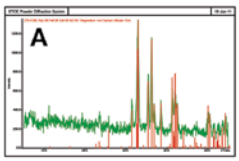
## Using TERRA XRD to Identify Ambiguous Coarse-Grained Minerals

A multinational company working on a Ni project was logging peridotite drill core. While logging core, a recurring subunit containing coarse-grained gray and black minerals proved difficult for the company geologist to characterize (Figure 1).

Since the minerals are coarse-grained, it was possible to quickly remove sufficient powdered mineral for XRD analysis using a metal scratcher. The samples were analyzed using the TERRA analyzer, and the results repeatedly showed that, contrary to expectations, the black mineral is plagioclase and the light gray mineral is orthopyroxene (enstatite), altered to amphibole to a varying degree.

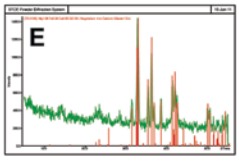
The realization that this subunit is a coarse gabbro made an accurate geological interpretation of the whole deposit possible. One of the mistaken interpretations of this subunit had been olivine spinifex texture. The ability to rule out this interpretation early in the process meant that time was not wasted pursuing a flawed interpretation.



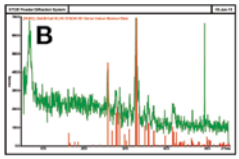

**Enstatite**

Matte, light grey, rounded



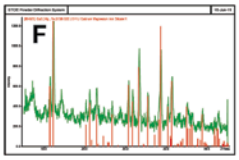

**Enstatite**

Matte light grey, outside of coarse layer in conventional cumulate



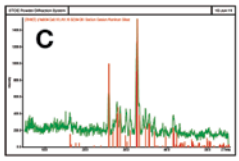

**Plagioclase**

Black, more angular, in this case matte.



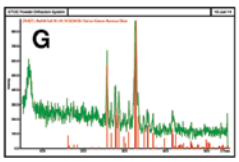

**Amphibole**

Light grey and exceedingly lustrous, blue tinted.



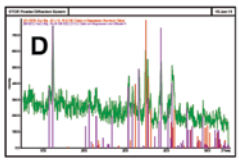

**Plagioclase**

Black, lath shaped. Lustrous, catches the light to reveal twinning.




**Plagioclase**

Black, lustrous and lath shaped.




**Amphibole + Enstatite**

Light grey and lustrous edges, core of matte light grey - being replaced.

Figure 1: Geological core sample showing scratch locations where material was removed for analysis by the Olympus TERRA portable XRD and the results.

## The Identification of Fine-grained Rocks

In this second example, the lithology in question (B) is fine-grained and light gray making it difficult to classify by observation alone. Due to an interfingered texture with a darker, ultramafic, magmatic unit (A) exhibiting cumulus textures, this rock was initially interpreted as an alteration product of the other (Figure 2).

However, repeated analysis using the TERRA portable XRD analyzer revealed that, far from being an alteration product, unit B actually contained only magmatic phases, including considerable plagioclase (anorthite). The interfingering texture, therefore, had to be magmatic, and the implications of this are very important for the ore genesis of the whole deposit.

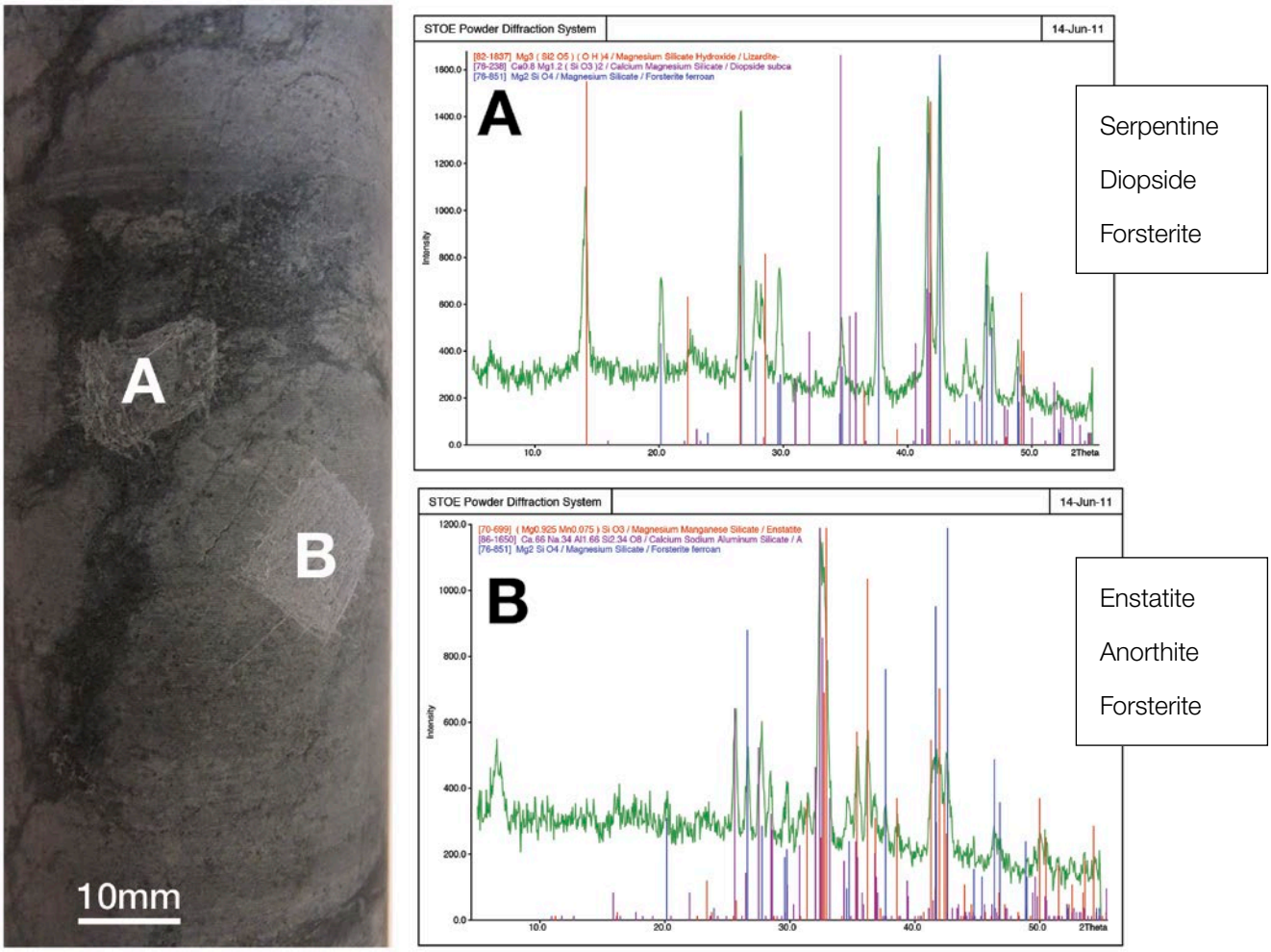



Figure 2: A close-up showing a fine-grained, light gray lithology (B) interfingered with a darker, ultramafic, magmatic unit (A) and the TERRA XRD mineral identifications.

In contrast to the time and expense of sending geological samples out for thin sectioning or laboratory XRD analysis, the TERRA analyzer allows you to make fast and accurate mineral identifications right in the core shed. The TERRA gives you the flexibility to test multiple samples as many times as required to be sure of their identification. The process saves time and money, both of which are invaluable when conducting expensive exploration and mining operations.

William Brownscombe studied Earth Sciences at Oxford before receiving an MSc in Mining Geology at the Camborne School of Mines. He is currently awaiting examination on his PhD at the Royal School of Mines. Mr. Brownscombe is interested in combining traditional field geology with geochemistry in mining exploration projects. He has worked in the field on projects in Ghana, Namibia, the UK, and Finland. He is currently LODE lab manager at the Natural History Museum, London and is running a laser ablation ICP-MS facility looking at trace elements in minerals as indicator and vectoring tools for mining geology projects.

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