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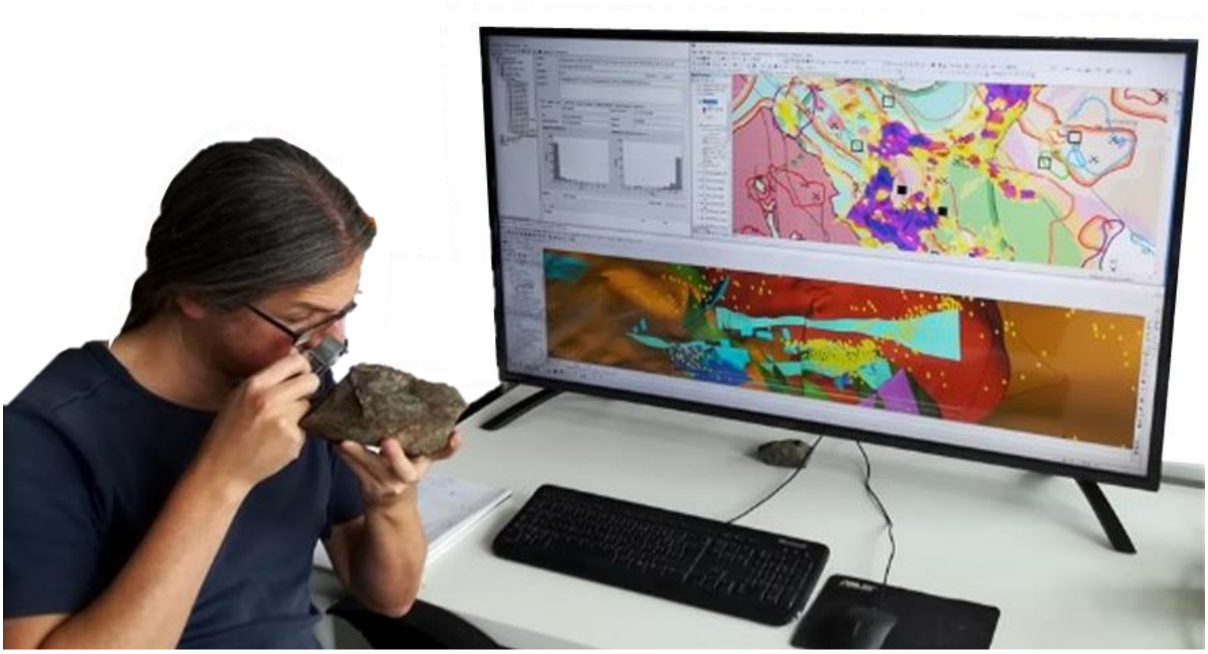

NEXT advances mineral predictive mapping with Self-Organizing Maps

Through its involvement in the EU funded Horizon 2020 New Exploration Technologies (NEXT) project, the company Beak Consultants GmbH, based in Freiberg, Germany has been able extend its “advangeo® 2D Prediction” software suite through the integration of Self-Organizing Maps. We invited Andreas Brosig who is a geologist at Beak Consultants to explain in more detail about the scope of mineral predictive mapping and the functionality of these Self-Organizing Maps.

In the cover picture for this write-up Andreas Brosig examines a sample of metalliferous rock collected in one of the mapped exploration zones (Photo credit: Gerald Volkmer). Recently, Andreas gave a 3-minute pitch style presentation about BEAK’s new mineral predictive mapping method at this year´s General Assembly of the European Geosciences Union, which can be accessed through this *link*.

Could you tell us what motivated your interest in geology?

As a child I was deeply into mineral and fossil collecting. During school holidays, I would badger my parents for short trips to the Alps or the Franconian Alb to hunt for fossils. Over time, I began to wonder how much harder it must be to discover minerals in the deep underground, compared to collecting samples from the surface. Later I learned that it is indeed a complicated, but also a very captivating topic as it involves many natural processes interacting over incredibly long time scales. Examining the remaining traces of these processes brings the opportunity to improve our understanding of what happened in the deep past. With this new approach to mineral predictive mapping, it is possible to find new mineral deposits even in areas where mining activities in past centuries are thought to have exhausted the hitherto known deposits.

What is predictive mineral mapping about?

Predictive mineral mapping enables the rapid targeting of areas that are a priori likely to have deposits and therefore offers a means to significantly reduce on exploration costs and also on lead times to the eventual opening of a new mine or the extension of an existing mine. At BEAK, we have been working with this approach for ten years now. Our application to a wide range of target areas and hence also different data sets enables us to continuously develop our in-house "advangeo® 2D Prediction" software. Essentially our software suite is built on the basis of data science concepts such as artificial intelligence which combines novel data mining approaches with machine learning.

We understand NEXT has brought the opportunity for BEAK to add a new algorithm to its prediction software suite. Could you give us more details about this new algorithm?

As our research colleague in NEXT, Tobias Bauer explained in your earlier interview (see here), the challenge to predict the location of ore deposits is huge and complex. The ingredients that are necessary for their formation are uniquely specific, as they are influenced by processes that occur not only at the regional scale but also at the very local scale. The new algorithm we have now added to our in-house "advangeo® 2D Prediction" software is based on the concept of Self-organizing maps. Self-organizing maps (SOM) are a useful tool to analyze and interpret the available datasets that have been collected, such as geophysical data that are brought in through field surveys and geochemistry data of stream sediments produced in a laboratory environment.

To start with, all these datasets are transformed from the 'usual' geocoded geographic space to the SOM space as illustrated in the schematic illustration of the workflow below. Within this SOM space, the data are then clustered according to overall similarity. By transforming the clusters back to geographic space, a novel means of geological interpretation of these clusters is facilitated. As shown in the schematic illustration of the workflow, the final outcome generated by our new algorithm takes the form of a mineral predictive map.

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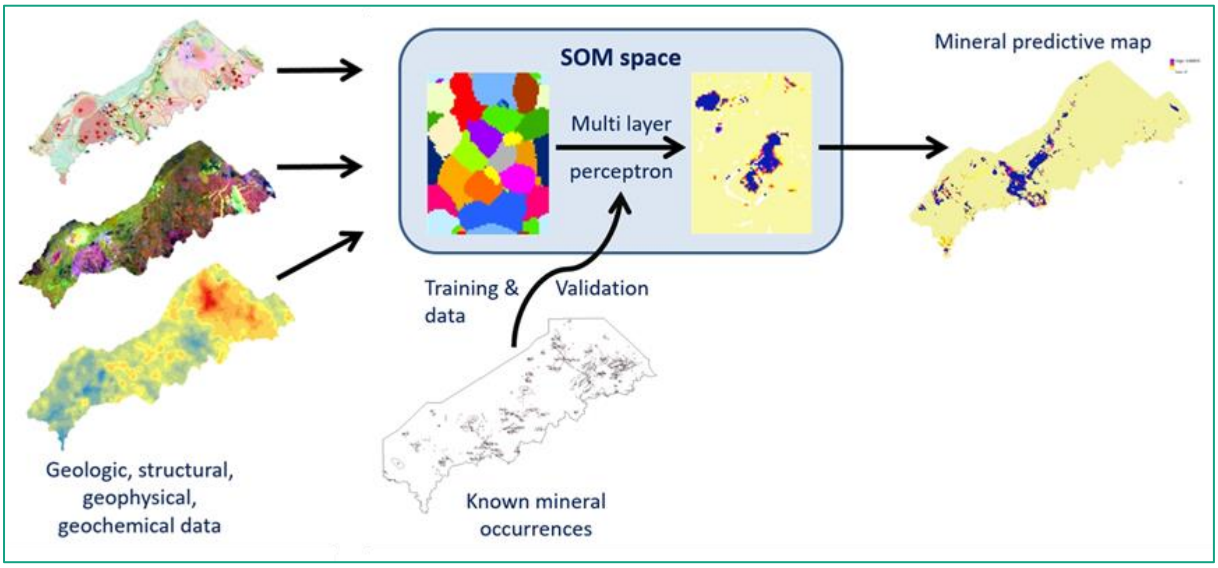

Figure 1. Schematic illustration of the workflow to obtain a mineral predictive map

In machine learning our algorithm is known as a perceptron. A perceptron is an algorithm for supervised learning of binary classifiers. There are two types of perceptrons: single layer and multi layer. Single layer perceptrons can learn only linearly separable patterns. As we are dealing with multi layer inputs, we take advantage of the known mineral occurrences as our training data in the SOM space. It is precisely the application of a multi layer perceptron in the SOM space that enables us to produce mineral predictive maps.

Can you tell us more about applications that confirm the validity of your new algorithm?

To date we have applied the method to tin deposits in the German part of the Erzgebirge. The training and validation data were compiled from available mining and exploration records. As input data for the SOM space we used reprocessed gravimetric, magnetic, stream sediment geochemistry, geologic and tectonic data sets. Potentially ore-controlling spatial relationships, such as the distance to different types of partly covered granite intrusions, were derived from a regional scale 3D geological model.

The resulting mineral prediction map allows the definition of as yet undocumented areas that reveal a high mineral potential and which thus present themselves as prime locations for detailed exploration activities.

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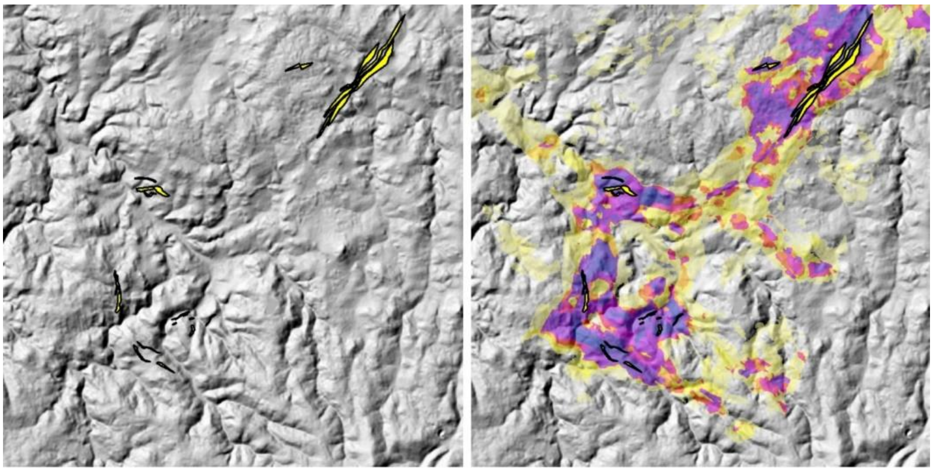

Figure 2. Left: A map of a part of the western Erzgebirge with known tin deposits.

Right: Our mineral predictive map shows the locations where additional deposits could exist.

As you will agree, the results are very promising and we are looking forward to validate our new algorithm in other locations, such as the Rajapalot gold deposit in Finland which is one of the sites in the NEXT project for the testing and validation of novel mineral exploration technologies.

How would you describe the main advantages brought by your application of predictive mapping?

To start with, I would consider that in comparison to other modeling approaches, our application makes the most of the available data sets as input data. The SOM space in particular allows us to speed up calculations dramatically. In the example of the Erzgebirge, we were able to produce the predictive map over a period of just a few days, including the time to organize all the input data in the geographic space. However, the ability to pinpoint to areas with a high mineral exploration potential based on desktop research is a clearly very promising advantage.

Figure 3. A sample on tin-enriched rock found in one of the predicted exploration zones.

(Photo credit: Peter Bock)

More about NEXT: www.new-exploration.tech

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