

Qualitative and quantitative prospectivity mapping and assessment of undiscovered mineral resources

4th March 2020

PDAC, Toronto, Canada

Short Course Description

Introduction

Predicting areas of undiscovered mineral resources and quantitative estimation of the area's potential endowment are among the most challenging tasks facing geoscientists in the exploration sector. These tasks are critical for economic assessment of exploration targets, as well as for decision-support related to land use planning and policy-making. Advancements in spatial data analysis and geographic information systems have enabled the development and implementation of various methods for mineral prospectivity mapping, i.e. mineral potential modelling (MPM). Quantitative assessment of undiscovered mineral resources (QMRA) has likewise evolved, and new software tools developed. Understanding the proper application of MPM and QMRA, their limitations, and how they are used together, is essential for geoscientists working in the field of natural resources. This course provides an overview of these topics and is of specific interest to geoscientists working in exploration and mining, but also for professionals who use the results of MPM and QMRA.

Content

This short course provides an overview of several commonly used knowledge- (conceptual) and data-driven (empirical) methods for qualitative mineral prospectivity mapping (MPM), and the 3-part methodology for quantitative mineral resource assessment (QMRA) of undiscovered mineral resources. The development and integration of these methods are reviewed, including theoretical underpinnings, practical implementation and recently developed software tools. Workflows and best-practices based on case studies in USA, Finland, Sweden, Greenland and Germany are demonstrated and discussed.

Top "take-aways"

With regards to MPM and QMRA, the short course will provide the participants with: a) a knowledge of the commonly used methods, b) an understanding of the basic principles of these methods, c) an understanding how the methods can be applied, and d) an understanding of the possibilities and limitations of the methods. More importantly, the course will focus on the practical demonstration of the methods by introducing selected software tools and highlighting results that can be acquired by using these tools.

Audience

Participants should have an interest in modelling or spatial data analysis. A basic understanding of concepts of GIS and basic experience in exploration or economic geology is required. No prior knowledge of software development or coding is required. BSc or MSc degree in geosciences will be helpful, but newcomers to the topic will also benefit from the introduction to the methods and tools.

Delivery strategy

The short course will consist of a series of presentations and demonstrations, as well as an interactive live exercise. The presentations and demonstrations will be informal and fluid to maximize engagement of the participants. Geological, geophysical, and geochemical datasets will be examined so as to appeal to a wide variety of interests. An interactive live exercise for quantitative mineral resource assessment using the free MAP software tool will be conducted as a group by all participants, with real-time evaluation of the results. Open question and discussion sessions will be an integral part of the short course.

Registration

<https://www.pdac.ca/convention/programming/short-courses>

Fee

Early rate: PDAC Member \$499.99; Non-Member 599.99

Regular rate: PDAC Member \$699.99; Non-member \$799.99; Student \$249.99

Short Course Presenter

Dr. Vesa Nykänen has been at the Geological Survey of Finland (GTK) since 1998. He gained his Ph.D. at the University of Oulu in 2008. He is currently Research Professor in geoinformatics, specialized in spatial data analysis and geological modelling with emphasis on mineral exploration. Currently, he is the scientific coordinator of NEXT project, which is an H2020-funded project developing new exploration technologies. Furthermore, he also coordinates the EIT-RawMaterials-funded project UpDeep. He is focusing on further utilization of GIS in geoscience applications and responsible on scientific and competence development of geoinformatics at GTK.

Dr. Johanna Torppa studied at the University of Helsinki. After her PhD (2008), she has been working for various research institutes and companies and as an independent researcher in geological and astronomical research projects. She has given presentations about various types of data analysis methods in several project meetings and workshops yearly as well as in scientific conferences.

Dr. Kalevi Rasilainen is an economic geologist with the Geological Survey of Finland. He has a M.Sc. in Geology and Mineralogy in 1985 and a Ph.D. in 1996 from the University of Helsinki. His main areas of experience are in economic geology, application of statistical methods on rock geochemical data and assessment of undiscovered mineral resources. Kalevi has been giving presentations in workshops, seminars and international conferences for over 30 years. During the last 11 years, he has lectured on assessing undiscovered mineral resources to both earth science professionals and students.

Dr. Joshua Coyan is a Research Geologist with the US Geological Survey's Mineral Resource Program. He holds an M. S. and a Ph. D. in Geology from Arizona State University where he studied the structural controls of orogenic gold on the southern Baja Peninsula. He has expertise in petroleum geology, ore deposits, geostatistics, and GIS. From 2011 to 2016 he worked for Chevron interpreting seismic data, building 3-dimensional models, and planning production and water-injection wells. Since joining the USGS four years ago, he has conducted quantitative mineral resource assessments of platinum group elements in the Duluth Complex and tungsten in the Great Basin of the western United States, provided short course instruction for mineral resource assessment to the Geological Survey of Brazil, and most recently, applied machine learning techniques to predict geologic and mineralogic processes.

Mr. Simon Thaarup is Geologist at the Geological Survey of Denmark and Greenland's (GEUS). He has done geological fieldwork in a number of different geological settings in West Greenland, e.g. mapping the zinc and lead potential in the Uummannaq-Upernavik district, ground truthing hyper spectral imagery in the Kangerlussuaq area, and investigating the gold potential of the Godthåbsfjord. He is responsible for GEUS' involvement in the EIT-RawMaterials-funded project UpDeep, which aims to identify and prioritize exploration targets, using low environmental impact exploration techniques. Simon holds an MSc in Geology (2015) from Aarhus University.

Mr. Andreas Brosig studied at TU Bergakademie Freiberg and TU Munich and holds a M.Sc. in Geology and Paleontology. He joined Beak Consultants GmbH from Germany in 2016. Between 2016 and 2019, he worked on 3D modelling and data processing for 2D and 3D predictive mapping with artificial neural networks, principally in the German-Czech Erzgebirge area. Since 2019, he is involved in the H2020-funded research project NEXT for data fusion and integration with self-organizing maps and the EIT-RawMaterials-funded project MAP for quantitative mineral resource assessment of the Erzgebirge area.

Mr. Andreas Knobloch studied at TU Bergakademie Freiberg and South Dakota School of Mines and Technology and holds a M.Sc. in Geology and Paleontology. He joined Beak Consultants GmbH from Germany in 2005. Until 2009, he has been involved in mineral resource management in Kosovo. Between 2011 and 2015, he worked in Rwanda for detailed survey and exploration in prospective mineral target areas. In 2018, he worked in DR Congo for mineral predictive mapping, using artificial neural networks. Since 2019, he is involved in the H2020-funded research project NEXT for data fusion and integration, using self-organizing maps.

Mr. Jens Rönnqvist graduated from Åbo Akademi University in 2006 and holds a M.Sc. degree in Geology and Mineralogy. Jens has had positions all from junior exploration geologist, mine geologist to senior geologist. Currently, he works as business development manager for Scandinavian GeoPool. In his present position, he is involved in developing geochemical exploration surveys in the UpDeep project, funded by EIT RawMaterial. During his career, he has been supervising and training field personnel in different phases of exploration, in green field geochemical surveys, drill programs and underground infill drilling programs in the Fennoscandian region.

Short Course Schedule

8:00 – 8:30 Morning coffee & tea

8:30 – 10:00 *Session 1*

- Welcome
 - Course Context & Schedule
- Mineral Predictive Mapping (MPM)
 - Introduction:
 - Overview & History
 - Methods:
 - Conceptual/ Knowledge-Driven:
 - Mineral Systems Approach
 - Fuzzy Logic
 - Empirical/ Data-Driven:
 - Self-Organizing Maps
 - Artificial Neural Networks
 - Weights of Evidence

10:00 – 10:15 Coffee & tea break

10:15 – 11:45 *Session 2*

- Software:
 - MPM/ ArcSDM
 - GisSOM
 - advangeo Prediction
 - UpDeep Webtool
- Question & Discussion

11:45 – 13:15 Lunch break

13:15 – 14:45 *Session 3*

- Case Studies:
 - USGS: Nevada/United States & Texas/United States
 - WISTAMERZ 2D and 3D/NEXT: Erzgebirge/ Germany
 - advangeo Prediction: CCZ/Pacific Ocean
 - UpDeep: Greenland
 - MPM: Lapland/ Finland
 - NEXT: Rajapalot/ Finland
- Question & Discussion

14:45 – 15:00 Coffee & tea break

15:00 – 16:30 *Session 4*

- Quantitative Mineral Resource Assessment (QMRA)
 - Introduction:
 - Overview & History
 - Methods:
 - Three-Part Assessment
 - Software:
 - MAP
 - Interactive Live Exercise with MAP
 - Case Studies:
 - MAP: Finland
 - MAP: Erzgebirge/Germany
 - Summary:
 - Comparison Results MPM vs. QMRA
 - Question & Discussion