

GEOLOGICAL SURVEY OF FINLAND

Open File Research Report 57/2021

**Mineral Prospectivity and Exploration Targeting –
MinProXT 2021 Webinar**

October 12–13 & 26–27, 2021

Abstract proceedings

Edited by Johanna Torppa and Bijal Chudasama

Figures in each abstract are prepared by the author(s) of that specific abstract.

Front cover: Terrain base map from ArcGIS® Earth, Earthstar Geographics – ESRI.
Picture by Riitta Turunen, GTK.

Layout: Elvi Turtiainen Oy

Espoo 2021

CONTENTS

INTRODUCTION.....	5
ABSTRACTS	
OUTCOMES FROM USING MINERAL POTENTIAL MODELLING AS A TOOL TO SUPPORT DECISION MAKING IN MINERAL EXPLORATION AND RESOURCE DEVELOPMENT.....	11
<i>Partington, G. A.</i>	
ANALYSING MINERAL SYSTEMS USING GEO-CONSTRAINED NON-EUCLIDEAN DISTANCES.....	15
<i>Jessell, M. W., Ogarko, V., Kelka, U., Pirot, G. and Lindsay, M. D.</i>	
HYBRID MINERAL PREDICTIVE MAPPING WITH SELF-ORGANIZING MAPS AND A MULTILAYER PERCEPTRON	19
<i>Brosig, A., Barth, A., Hielscher, P., Legler, C., Schaefer, S., Bock, P. and Knobloch, A.</i>	
BIG (TARGETING CRITERIA) DATA – LITTLE (TRAINING) DATA.....	23
<i>Ford, A.</i>	
APPLICATION OF C-C FRACTAL MODELLING TO SEPARATE ANTHROPOGENIC FROM GEOGENIC PATTERNS	27
<i>Sadeghi, B. and Cohen, D. R.</i>	
PROSPECTIVITY MODELLING TO PACTICAL EXPLORATION TARGETING: BRIDGING THE GAP?.....	31
<i>Lisitsin, V. A.</i>	
GISSOM SOFTWARE FOR MULTIVARIATE CLUSTERING OF GEOSCIENTIFIC DATA	35
<i>Torppa, J. and Chudasama, B.</i>	
INTRODUCING THE DATABASE OF GLOBAL LAYERED INTRUSIONS.....	39
<i>Smith, W. D. and Maier, W. D.</i>	
MAPPING PORPHYRY MINERAL SYSTEM ELEMENTS AT THE TERRANE SCALE.....	43
<i>Busuttil, S.</i>	
IOCG PROSPECTIVITY MODELLING FOR GAWLER GREENFIELD REGIONS – SECOND PLACE SUBMISSION IN THE EXPLORESA COMPETITION	47
<i>Rodda, M.</i>	
REGIONAL-SCALE EXPLORATION TARGETING OF CARBONATITE –ALKALINE COMPLEX-RELATED REE DEPOSITS IN NORTHWESTERN INDIA.....	51
<i>Aranha, M., Porwal, A. and González-Álvarez, I.</i>	
THREE-DIMENSIONAL WEIGHTS OF EVIDENCE MODELING OF CONCEALED ORE DEPOSITS USING THE 3DWOFE SOFTWARE PACKAGE	55
<i>Farahbakhsh, E., Hezarkhani, A., Bahroudi, A., Sadeghi, B. and Chandra, R.</i>	
MINERAL PREDICTIVE MAPPING: FROM INTUITION TO QUANTITATIVE HYBRID 3D MODELLING	59
<i>Barth, A., Brosig, A., Hielscher, P., Knobloch, A. and Hanelli, D.</i>	
MAPPING MULTIVARIATE ORE OCCURRENCE DATA WITH CORRESPONDENCE ANALYSIS.....	63
<i>Rosera, J. M.</i>	

DATA-DRIVEN PROSPECTIVITY MODELLING OF SEDIMENT-HOSTED MINERAL SYSTEMS.....	67
<i>Lawley, C. J. M., McCafferty, A. E., Graham, G. E., Gadd, M. G., Huston, D. L., Kelley, K. D., Czarnot, K., Paradise, S., Peter, J. M., Hayward, N., Barlow, M., Emsbo, P., Coyan, J. and San Juan, C.</i>	
RESOURCE ASSESSMENT USING ADVANCED DATA ANALYTICS APPLIED TO MULTI-ELEMENT GEOCHEMICAL SURVEY DATA	71
<i>Grunsky, E. C.</i>	
MODELLING OF CU-AU PROSPECTIVITY IN THE CARAJÁS MINERAL PROVINCE (BRAZIL) THROUGH MACHINE LEARNING: DEALING WITH IMBALANCED TRAINING DATA.....	75
<i>Prado, E. M. G., Souza Filho, C. R., Carranza, J. M. and Motta, J. G.</i>	
BEYOND THE PROSPECTIVITY MAP: TACKLING THE GROWTH CHALLENGE FACING THE MINERAL INDUSTRY WITH THE APPLICATION OF MINERAL SYSTEMS	79
<i>Januszczak, N.</i>	
MINERAL PROSPECTIVITY MAPPING FOR CRITICAL RAW MATERIALS AT THE EUROPEAN SCALE WITH THE CBA METHOD	83
<i>Bertrand, G., Sadeghi, M., de Oliveira, D., Tourlière, B., Arvanitidis, N., Gautneb, H., Gloaguen, E., Törmänen, T., Reginiussen, H., Decrée, S., Pereira, A. and Quental, L.</i>	
MINERAL PROSPECTIVITY USING A VNET FRAMEWORK	87
<i>McMillan, M., Haber, E., Belliveau, P. and Koziol, C.</i>	
MINERAL SYSTEM APPROACH FOR THREE-DIMENSIONAL TARGET GENERATION OF IRON OXIDE (±APATITE) MINERALISATION IN THE BLÖTBERGET MINING AREA, BERGSLAGEN, SWEDEN	91
<i>Sadeghi, M., Bastani, M., Luth, S., Malehmir, A. and Marsden, P.</i>	
MACHINE LEARNING METHODS FOR ASSISTING IN THE IDENTIFICATION OF DRILLING TARGETS WITHIN THE RAJAPALOT PROJECT AREA IN FINLAND	95
<i>Chudasama, B. and Torppa, J.</i>	
MINERAL RESOURCE ASSESSMENT AND MAPPING OF PROSPECTIVITY BY THE GEOLOGICAL SURVEY OF BRAZIL: A WORK IN PROGRESS	99
<i>Tavares, F. M., da Silva, G. F., Costa, I. S. L., Souza-Gaia, S. M., Costa Queiroz, L., Bittencourt Lima, R., Meloni, R. E., Matos, D. R., da Silva, A. D., Guimarães, S. B., Polo, H. J. O., Serafim, I. C. C. O. and Almeida, M. E.</i>	

MINERAL PROSPECTIVITY MAPPING FOR CRITICAL RAW MATERIALS AT THE EUROPEAN SCALE WITH THE CBA METHOD

by

*Bertrand, G.^{1,2}, Sadeghi, M.³, de Oliveira, D.⁴, Tourlière, B.¹, Arvanitidis, N.³, Gautneb, H.⁵,
Gloaguen, E.^{1,2}, Törmänen, T.⁶, Reginiussen, H.³, Decrée, S.⁷, Pereira, A.⁴ and Quental, L.⁴*

¹ BRGM (Geological Survey of France), Orléans, France

² ISTO UMR7327 (Univ. of Orléans, CNRS, BRGM), Orléans, France

³ SGU (Geological Survey of Sweden), Uppsala, Sweden

⁴ LNEG (Geological Survey of Portugal), Alfragide, Portugal

⁵ NGU (Geological Survey of Norway), Trondheim, Norway

⁶ GTK (Geological Survey of Finland), Rovaniemi, Finland

⁷ GSB (Royal Belgian Institute of Natural Sciences – Geological Survey of Belgium),
Brussels, Belgium

E-mail: g.bertrand@brgm.fr

This contribution presents pan-European prospectivity maps for lithium, cobalt, natural graphite, niobium, tantalum, phosphates and rare earth elements that were produced by the GeoERA FRAME project. These maps are based on the cell-based association (CBA) method, which was specifically developed for mineral prospectivity mapping at regional to continental scales. The purpose of this method is to address issues such as uncertainties in the location of cartographic objects and the need to consider geological contexts. Several options to calculate favourability scores were statistically tested and compared to improve the accuracy of the method and produce the final maps.

INTRODUCTION

Lithium (Li), cobalt (Co) and natural graphite are essential for energy storage technologies and electric transportation. Niobium (Nb) is essentially used to produce high-strength low-alloy (HSLA) steels for construction, the automotive industry and pipelines. Tantalum (Ta) is needed for applications in electronics (capacitors), metallurgy (crucibles, heat exchangers, etc.), chemistry, superalloys or carbides (e.g., cutting tools). Phosphates are largely used across the world for the production of fertilizers, and rare earth elements (REE) are used in a wide range of equipment for green energy and digital technologies. All these commodities are considered critical raw materials (CRM) for the EU (2020). As these elements are mostly produced outside Europe, their supply for European industry is potentially a threat. Moreover, primary resources should be exploited as a priority in Europe