

Targeting & Geological Framework Specialists



Capability Statement (2022)

**Success in Targeting Challenges** 

3<sup>rd</sup> Prize: Integra Gold Rush

3rd Prize: Karelian Gold Rush

# company overview



Corporate Geoscience Group (CGSG) are a group of highly experienced, industry-leading experts with a common goal and passion for delivering high-quality and high-impact scientific, corporate and strategic results, enhancing the value of mineral exploration projects globally.

Our core specialties and competencies include:

- □ Deep understanding of gold, copper, uranium mineral systems
- Discovery-oriented, fully integrated geoscience framework and targeting studies
- □ Structural and field geology, geochemistry and geophysics
- Project generation
- Project appraisals and independent technical reviews
- □ Exploration strategy and project management
- □ Original initiatives designed to fast-track mineral discovery and organic growth

With offices in Australia and Africa, and a network of associates around the globe, our group prides itself on delivering real, meaningful and value-enhancing outcomes for our partners and clients worldwide.

# success in targeting competitions





Integra Gold Rush



Karelian Gold Rush

#### 3<sup>rd</sup> prize winner: **Integra Gold Rush Challenge**, 2014-15

- □ High-profile global exploration targeting with >1,300 participants and C\$1M in prize money.
- □ We crunched >6TB of historic data collected over 70 years of mining and exploration activity at the 12Moz Au Sigma-Lamaque gold mines, Quebec.
- We generated and prioritised 25 targets, representing un- or underdrilled ore extensions and possible intrusive plugs (prospective gold hosts) and fault zones (prospective host structures).

#### 3<sup>rd</sup> prize winner: **Karelian Gold Rush Challenge**, 2014-15

- □ Global crowd-sourced targeting challenge that sought innovative and out-ofthe-box solutions for targeting the next big gold discovery in a 400km2 tract of the Karelian Greenstone Belt, Finland.
- We generated and prioritised 10 conceptual targets derived from an integrated assessment and modelling of geology, geochemistry, remote sensing geophysical and drill hole data.

# key consultants



#### **Dr Oliver Kreuzer**

MSc, PhD, MAIG RPGeo, MAusIMM

Partner & Principal Consultant, Perth

Oliver is a geoscientist with a broad skill set in structural, generative and corporate geology honed during a 20+ year career in applied research and mineral exploration across a wide range of precious, base, energy and battery metals projects in Australia, Africa, the Americas, Europe and Asia. He specializes in integrated geological framework and targeting studies at the continent to mine scales. His work directly contributed to new company floats (ASX:AUC, ASX:RGU; ASX:CY5; ASX:92E; ASX:NKL), company transforming project acquisitions (ASX:AWV; ASX:GLA) and new discoveries. Oliver's passion lies in the application of superior geoscience to exploration targeting and shortening the time frame to discovery. His publication record covers a broad range of topics such as structural and ore deposit geology, exploration targeting and risk-value practice and decision-making applied to mineral exploration.



#### **Dr Kris Butera**

BSc (Hons), PhD, FAusIMM, MAIG

Partner & Principal Consultant, Melbourne

Kris is a discovery and corporate geologist with an extensive history in applying novel approaches to geoscience and a particular interest in gold, copper-gold and strategic metal deposits. Incorporating advanced techniques and strategies with modern geophysical and geochemical approaches, Kris builds meaningful high order discovery target models for efficient testing. Kris has led a number of significant mineral discoveries across eastern Australia, and was instrumental in several discoveries across the globe. Having worked across the spectrum from early stage exploration, through to development and corporate geology, Kris understands the importance of undertaking exploration programs and geoscience studies within the broader commercial and corporate needs of a company. He is also an astute deal maker, company founder and executive leader, all of which has helped developed the perspective to generate efficient and effective discovery outcomes for clients.



# key associates



#### Mr Kwesi Appiah

BSc, MAIG, MGHGE

Senior Geologist - West Africa, Accra

Kwesi has over 10 years' experience as a gold and base metals exploration, mining and consulting professional. His experience covers greenfields and brownfields exploration, feasibility studies and open pit mining, including the management and supervision of substantial exploration and mine development programs in Ghana, Cote d'Ivoire, Mali, Tanzania and Senegal. Kwesi was a member of the teams that added 0.5Moz Au to the feasibility study target of and significantly increased monthly production at the Wassa gold mine, Ghana, and significantly extended the life-of-mine target at Syama gold mine, Mali. Kwesi has been affiliated with CGSG since 2013 and was instrumental in the success of several substantial, West Africa-focused consulting projects.



#### **Dr Amanda Buckingham**

BSc (Hons), PhD

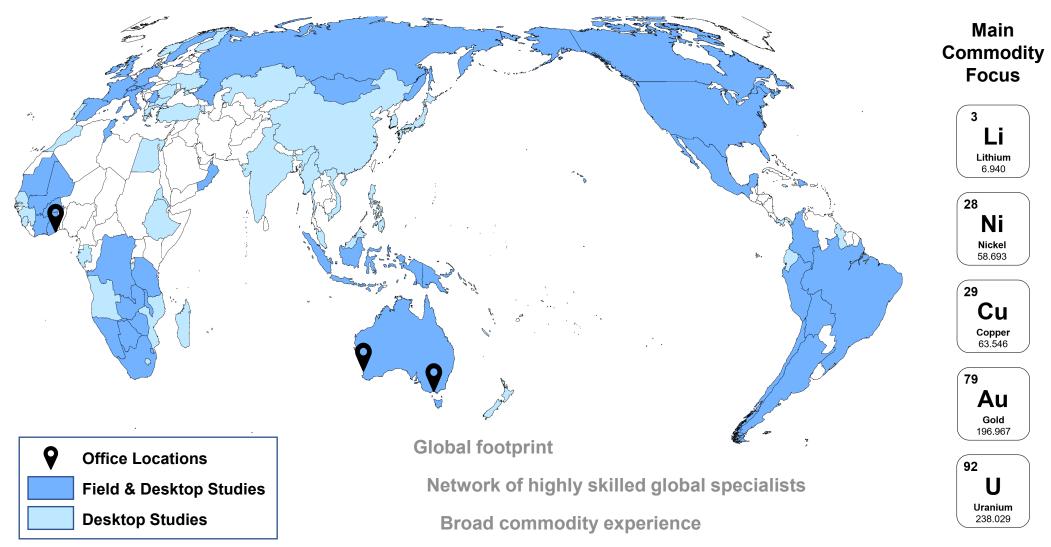
Principal Geophysical Associate, Perth

Amanda is an award-winning geophysicist widely recognised for her cutting-edge, industry-leading approaches to geophysical processing and targeting. She has over 20 years experience as a geophysicist, working in exploration, consulting, airborne acquisition and academia. She has worked on projects on all continents and across a broad range of commodities and deposit styles. In 2007, Amanda founded Fathom Geophysics, an industry-leading geophysical group that has developed worlds-best technology for targeting under cover thereby significantly increasing the chance of discovery. Amanda's early career was at major mining companies such as Rio Tinto and several listed juniors. She has wide-ranging exploration experience in North and Sub-Saharan Africa, North and South America, South East and Central Asia, Russia and Europe.



# worldwide multi-commodity experience









Tri-Star Group
(Private)

- Assessment of the Western Australian minerals industry, covering a diverse range of regulatory, access and infrastructure and technical aspects.
- Detailed review of the **most significant, established mineral provinces and key commodities** mined in Western Australia.
- □ Identification of emerging mineral provinces, underexplored areas and mineral deposit types that are likely to occur in Western Australia but are currently not known to exit.
- □ Ranking of mineral provinces according to various criteria.
- □ Recommendations on the **most suitable investment types** for the client in Western Australia and possible next steps.



Tri-Star Group
(Private)

- Review of the South Australian uranium industry.
- Comprehensive reviews of targeted investment projects, including assessments of the quality of the respective resource estimates and exploration upside, identification of possible mining and/or processing problems, identification of possible ESG issues, identification of the next logical stage in each project's lifecycle and near-term capital requirements, and comparison of each project in terms of level of advancement, incremental value-add potential, and marketability.
- Comprehensive reviews of the six largest uranium deposits in South Australia, covering the exploration techniques that led to their discoveries, geology setting and controls, mining and processing methods, infrastructure, financial evaluations and the corporate structures of the project owners.





Bulletin Resources Ltd (ASX:BNR)

- □ Geological framework and targeting study covering BNR's Lake Rebecca gold project and surrounds (>4,900km²) in the Archean Kurnalpi Terrane, a tectonic element of the Eastern Goldfields Superterrane, Yilgarn Craton, Western Australia.
- The **two-month** study, undertaken in close collaboration with BNR staff and Fathom Geophysics Australia Pty Ltd, included, a detailed review of all available data, summary of the gold systems in the Kurnalpi Terrane as well as a **litho-structural** (solid geology) interpretation, which identified key targeting elements such as the previously unrecognised 'Rebecca Complex' and fault-fracture corridors believed to control the location of the gold deposits in the study area.
- Our study delivered >20 ranked exploration targets and a set of recommendations as to the way
  forward at Lake Rebecca through exploration, discovery and strategic acquisitions.



International Atomic Energy Agency

- **Three-month study** aimed at a set of **descriptive deposit models** for each of the >60 uranium deposit types, subtypes and classes recognised in the IAEA classification scheme.
- Whilst invaluable for communication, reference and learning, the IAEA classification scheme includes many variations on a theme and comprise countless geological variables, many evident at the deposit scale only.
- The **main aim** of this study was to **translate the descriptive models** covered by the IAEA classification scheme **into process-based uranium deposit models** generated in the framework of a **mineral systems approach**.
- A key intention with the uranium mineral systems models is the **provision of an enhanced scheme** in which uranium deposits are presented according to the **critical genetic processes** that shape them. Such a scheme has **greater predictive power** and, thus, is better suited to studies concerned with the number, size and location of **speculative uranium resources**.





St Barbara Ltd (ASX:SBM)

- □ This **two-month study** was designed to **improve the current scoring system** used by SBM to financially model and rank its portfolio of exploration targets across its operating regions and targeted deposit types.
- The main aspects of this study were to (i) review SBM's current scoring charts and amend these if necessary, (ii) develop **new scoring charts for orogenic and intrusion-related gold systems** in SBM's operating regions, (iii) generate new target analogue templates for orogenic and intrusion-related gold systems in SBM's operating regions, and (iv) develop an exploration targeting model for orogenic gold systems in central Victoria, Australia.
- A key ingredient in the success of this study was the close collaboration and regular communication between CGSG and SBM.



Perseus Mining Ltd
(ASX:PRU)

- Major post-mortem and targeting study covering PRU's >10Moz Au Edikan Gold Mine project in the Kumasi Basin, Ghana.
- The main aims of this **three-month multi-consultant study** were to review and update the findings of a previous geological framework and targeting study undertaken by CGSG in 2016-17 that led to the **Esuajah Gap discovery** (c. 9m @ 1.2g/t, incl. 5m @ 13.7g/t Au; c. 52m @ 2.0g/t Au, incl. 5m @ 8.4g/t Au).
- The follow-up study, which involved a detailed review of the exploration undertaken by PRU since 2016-17, **3D inversion** of the VTEM data, **3D modelling** of the drill hole database and a **review of selected drill cores and outcrop locations**, delivered, for example, a much improved understanding of the controls on gold mineralisation and new insights into the architecture of the ore shoots at Edikan.
- Our group **identified 35 targets**, including newly generated targets as well as thoroughly reviewed and revised targets previously proposed as part of the 2016-17 framework study.





St Barbara Ltd

(ASX:SBM)

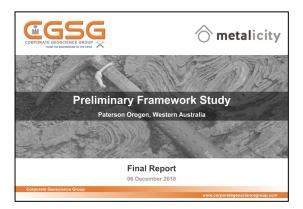
- □ Comprehensive **geological framework and targeting study** covering SBM's Lake Wells gold project and surrounds (**>4,500km**²) in the Burtville and Yamarna terranes, eastern Yilgarn Craton, Western Australia.
- □ The **two-month multi-consultant study** generated new geophysical and geochemical targeting products, a new lithostructural (solid geology) interpretation, a detailed summary of the known gold deposits within the Burtville and Yamarna terranes and an integrated targeting model.
- □ We also generated >13 ranked exploration targets contained with two recommended exploration focus areas that are likely to offer the best chance of discovery.



St Barbara Ltd (ASX:SBM)

- Substantial **geological framework and targeting study** covering SBM's Pinjin gold project and surrounds (>8,250km²) in the Archean Kurnalpi Terrane, a tectonic element of the Eastern Goldfields Superterrane, Yilgarn Craton, Western Australia.
- □ The **two-month multi-consultant study**, undertaken in close collaboration with SBM staff, included, for example, a detailed review of all available data, geophysical enhancement filtering, a litho-structural (solid geology) interpretation and the generation of a targeting model for gold systems in the Kurnalpi Terrane.
- Our study delivered >25 ranked exploration targets, with detailed proposals for follow-up of the top-ranked targets, and a set of recommendations as to how to transform Pinjin into a future production centre through exploration, discovery and strategic acquisitions.
- This study also found that large areas within SBM's Pinjin project and surrounds, including highly prospective areas, had received no, or only cursory, exploration.





Metalicity Ltd
(ASX:MCT)



Monument Mining Ltd (CVE:MMY)

- □ Major geological framework and targeting study, initially covering the northwestern (NW) Paterson Orogen (>75,000km²). An immediately requested follow-up study covered the southeastern (SE) Paterson/Petermann Orogen (>75,000km²) for a combined >150,000km² study area.
- Advanced geophysical filtering and algorithm-driven structure detection and depth-to-basement modelling in combination with lithostructural interpretations served to **highlight areas of shallow to moderate cover thickness** within MCT's tenure and elsewhere in the Paterson Orogen, representing key targets.
- □ We identified several high-priority targets within MCT's tenure package, including along the El Paso gold-copper corridor that encompasses the recent Winu and Havieron discoveries.
- Our work also identified an **outstanding copper opportunity on open ground**; the Warburton project in the SE Paterson. This project hugs a >12km-long exhalative copper horizon spatially associated with the same gravity structure as the Nifty copper belt in the NW-Paterson. Historic diamond drilling returned up to 4.0m @ 2.8% Cu and 5.8g/t Ag and 3.5m @ 8.2% Cu and 16.4g/t Ag.
- **3D structural targeting study** of MMY's Murchison gold project near Meekatharra, Western Australia, led by Orefind (Dr Jun Cowan), one of CGSG's close associates.
- The study **identified several new shallow targets** down-plunge of historically mined gold deposits at Burnakura and Gabanintha.
- A 'blue sky' targeting exercise using all available geological, geochemical and geophysical data clearly illustrated some of the key structures controlling the location of gold mineralisation at the camp to district scale and identified several regional targets, none of which had been tested by the previous operators. In particular, this study highlighted the potential for large granitoid-hosted gold systems at the historic Lewis-Reward operations and the Mt Bowie prospect.
- CGSG's role in this study was to **collect structural information in the field** in support of and help constrain Orefind's 3D structural and geological modelling, and undertake the regional 'blue sky' targeting.





## Gold Road Resources Ltd (ASX:GOR)

- □ Fully integrated solid geology interpretation of the Archean Yamarna, Dorothy Hills and Mount Venn greenstone belts, a >26,000km² area in the eastern Yilgarn Craton. Significant gold resources have been identified by GOR at Gruyere, Central Bore, Attila and Alaric that combine for a total of >6.5Moz Au.
- The **six-month multi-consultant study** included a detailed review of the available data, geochemical analysis, litho-structural interpretation of magnetic and gravity data and significant field component that included targeted site visits and the review and logging of several 1,000m of diamond drill core.
- ☐ The resulting geological map and stratigraphic legend forms the **basis for all current targeting and exploration efforts** by GOR in the Yamarna and Dorothy Hills belts.
- The project also included a **mentoring role** as part of the diamond drill core logging component of the project.

#### **Summary Report**

Geological Framework & Targeting Study, Tanami Project, Northern Territory

Prepared for Matt Briggs, Managing Director Neil Jones, Exploration Manager



ABM Resources NL (ASX:ABU)

- Major **geological framework and targeting study** covering **>46,000km**<sup>2</sup> of the Granites-Tanami orogen, a remote Paleoproterozoic terrane with a known endowment of **>**20Moz Au.
- □ The **three-month multi-consultant study**, undertaken in close collaboration with ABU staff, included a significant database QAQC component, creation of an updated, vetted GIS, review of the available geochemical data, construction of an integrated regional solid geology map, generation of new conceptual and targeting models, compilation of past exploration activities and a detailed targeting study that delivered >65 ranked exploration targets.
- One of the key results of this study was an interpretation from seismic and gravity data of the deeper **crustal structural architecture** ("thick-skinned" tectonic domain) and how it may have interacted with that of the upper crust ("thin-skinned" tectonic domain) to control the location of gold mineralisation within the Granites-Tanami orogen.



#### **Summary Report**

An Integrated Review of Gold Prospectivity: Massigui & Dankassa Projects and Baoulé-Mossi Domain of Southern Mali

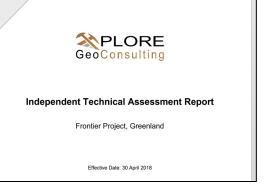
Prepared for

Dr Andy Wilde

Exploration Manager



#### Birimian Gold Ltd (ASX:BGS)



Greenfields Exploration Ltd
(Unlisted)

- □ **Geological framework and targeting study** covering BGS' Massigui and Dankassa gold projects and wider Baoulé-Mossi domain, Mali, a >70,000 km² Birimian-age terrane with an endowment >22Moz Au.
- □ The **one-and-a-half-month multi-consultant study** included database QAQC, detailed reviews and compilations of the main gold deposits in southern Mali and adjacent parts of Guinea, Côte d'Ivoire and Burkina Faso and the deformation history and mineralisation events relating to the Birimian of southern Mali, generation of new conceptual ore deposit and targeting models, compilation of exploration index maps and a detailed targeting study.
- ☐ The targeting study **identified 22 broad regional target zones** in support of potential project acquisition or generation of new projects **and 68 geophysical, geochemical and conceptual targets**.
- □ BGS (now Mali Lithium Ltd, ASX:MLL) announced plans to commence field work designed to evaluate the most highly ranked targets as part of its gold exploration activities.
- Independent technical review (ITR) of Greenfields' Frontier project.
- □ Greenfields is a highly progressive, project generator-type company exploring a remote, 13,000km² tract of central eastern Greenland for large sediment-hosted copper and magmatic nickel deposits.
- Our ITR was required for a prospectus in support of the company's fundraising activities with the initial seed capital proposed to be raised via crowdfunding.
- Whilst the crowdfunding activities were unsuccessful, Greenfields subsequently succeeded with securing mid-tier mining house IGO Ltd (ASX:IGO) as a joint venture partner.



#### **Summary Report**

A Framework Study of Exploration Potential at the Edikan Gold Mine Project, Ghana

Prepared for Dr Doug Jones
Group Exploration Manager



## Perseus Mining Ltd (ASX:PRU)

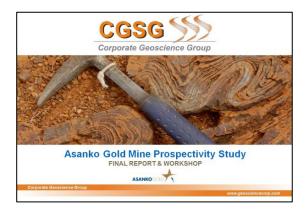
- □ Major geological framework and targeting study covering PRU's >10Moz Au Edikan Gold Mine project in the Kumasi Basin, Ghana.
- Our group identified >50 targets, including 10 high priority targets, that are now being field checked and assessed for immediate follow-up, including drilling.
- □ The study involved a compilation of all available geological, geochemical, geophysical and drill data to develop a 3D lithostructural interpretation that was used to generate a predictive model to identify the most prospective ground and provide a priority-ranked list of targets.
- □ The study also included database QAQC and a large geophysical component, including the processing and filtering of new and legacy EM, IP, magnetic, gravity and radiometric data.



Patagonia Gold plc (LON:PGD)

- ☐ **Tenement rationalisation study** covering PGD's extensive tenement portfolio (>3,500km²) in the Deseado Massif, Argentina, also **including a belt-wide target generation component**.
- Our group completed a detailed appraisal of all previous exploration, reviewed and interpreted the geology, structure and tectonics, and identified 30+ target areas with potential for discovery of new, significant low sulphidation epithermal gold-silver systems and resource development opportunities.
- ☐ The targeting was supported by **state of the art processing and filtering** of gravity, magnetic, radiometric and remote sensing data.
- ☐ The study results and recommendations helped PGD's exploration team to **rationalise their tenement portfolio** and **secure internal funds** for team expansion and fast-tracking discovery through evaluation and drill testing of high priority exploration targets and acquisition of new, highly prospective ground.





Asanko Gold Inc (TSX:AKG, NYSE:AKG)

- □ Major near-mine to regional geological framework, targeting and prospectivity modelling study covering AKG's Asankrangwa Gold Mine project and the entire Kumasi Basin, Ghana.
- □ Traditional exploration targeting techniques were used in conjunction with GIS-driven probabilistic modelling techniques for predicting gold potential.
- Our group generated 25 high priority brown- and greenfields targets and acquisition targets within the wider Kumasi Basin.
- Outcomes and recommendations helped AKG's exploration team to secure significant internal funds for expanding the exploration team and fast-tracking discovery through evaluation and drill testing of high priority exploration targets.
- The study generated **strong media coverage** for CGSG and resulted in AKG commissioning follow-up work.



Cygnus Gold Ltd (ASX:CY5)

- Prospectivity modelling and targeting study for granulite-hosted gold mineral systems in the underexplored southwestern Yilgarn Craton, Western Australia.
- Our group **generated a portfolio of 10 highly prospective gold projects on open ground** that is now held by the Company.
- The Company's **Bottleneck project contains a shallow**, **high-grade gold discovery** that is open down-plunge and along strike. Several additional prospects were identified within the Company's project areas.
- Work cumulated in the 2018 IPO and float of Cygnus at the Australian Securities Exchange, strong funding support from cornerstone investors Resource Capoital Funds (RCF), Southern Cross Capital and Gold Road Resources Ltd (ASX:GOR). GOR also entered into three earn-in joint ventures with Cygnus.
- ☐ Greater AUD7.5M raised to date for exploration of Cygnus' SW Yilgarn exploration portfolio.

## selected articles



- □ Bruce, M., **Kreuzer, O.P.**, Wilde, A., Buckingham, A., Butera, K., Bierlein, F. (2020). Unconformity-type uranium systems: A comparative review and predictive modelling of critical genetic factors. Minerals, 10(9), 738 [https://www.mdpi.com/2075-163X/10/9/738].
- □ Chudasama, B., Porwal, A.K., **Kreuzer, O.P.**, Butera, K. (2016). Geology, geodynamics and orogenic gold prospectivity modelling of the Paleoproterozoic Kumasi Basin, Ghana, West Africa. Ore Geology Reviews, 78, 692-711.
- Chudasama, B., Kreuzer, O.P., Thakur, S., Porwal., A.K., Buckingham, A. (2018). Surficial uranium mineral systems in Western Australia: Permissive tracts and undiscovered endowment. In: Quantitative and Spatial Evaluations of Undiscovered Uranium Resources (IAEA-TECDOC-1861), International Atomic Energy Agency, pp. 446-614.
- □ Hronsky, J.M.A., **Kreuzer, O.P.** (2020). Applying spatial prospectivity mapping to exploration targeting: Fundamental practical issues and suggested solutions for the future. Ore Geology Reviews, 107, 647-653.
- Kreuzer, O.P., Blenkinsop, T.G., Morrison, R.J., Peters, S.G. (2007). Ore controls in the Charters Towers goldfield, NE Australia: constraints from geological, geophysical and numerical analyses. Ore Geology Reviews, 32(1-2), 37-80.
- □ **Kreuzer, O.P.**, Etheridge, M.A., Guj, P. (2007). Australian junior exploration floats, 2001 to 2006, and their implications for IPOs. Resources Policy, 32(4), 159-182.
- □ **Kreuzer, O.P.**, Etheridge, M.A., Guj, P., McMahon, M.E., Holden, D.J. (2008). Linking mineral deposit models to quantitative risk analysis and decision-making in exploration. Economic Geology, 103(4), 829-850.
- Kreuzer, O.P., Markwitz, V., Porwal., A.K., McCuaig, T.C. (2010). A continent-wide study of Australia's uranium potential. Part I: GIS-assisted manual prospectivity analysis. Ore Geology Reviews, 38(4), 334-366.

## selected articles



- □ Kreuzer, O.P., Miller, A., Peters, K., Payne, C., Wildman, C., Partington, G.A., Puccioni, E., McMahon, M.E., Etheridge, M.A. (2015). Comparing prospectivity modelling results and past exploration data: a case study of porphyry Cu-Au mineral systems in the Macquarie Arc, Lachlan Fold Belt, New South Wales. Ore Geology Reviews, 71, 516-544.
- □ **Kreuzer, O.P.**, Yousefi, M., Nykänen, V. (2020). Introduction to the special issue on spatial modelling and analysis of ore-forming processes in mineral exploration targeting. Ore Geology Reviews, https://doi.org/10.1016/j.oregeorev.2020.103391.
- □ **Kreuzer, O.P.**, Buckingham, A., Mortimer, J., Walker, G., Wilde, A., Appiah, K. (2020). An integrated approach to the search for gold in a mature, data-rich brownfields environment: A case study from Sigma-Lamaque, Quebec. Ore Geology Reviews, https://doi.org/10.1016/j.oregeorev. 2019.102977.
- □ **Kreuzer, O.P.**, Fairclough, M., Bruce, M., Jaireth, S, Mihalasky, M., Poliakovska, K. (2020). Descriptive uranium deposit and mineral system models. International Atomic Energy Agency, Non-Serial Publication, ISBN: 978–92–0–109320–2, 313 p.
- Tourigny, G., Tranos, M.D., Masurel, Q., Kreuzer, O.P., Brammer, S., Owusu-Ansah, K., Yao, D., Hayford, T. (2019). Structural controls on granitoid-hosted gold mineralization and paleostress history of the Edikan gold deposits, Kumasi Basin, southwestern Ghana. Mineralium Deposita, 54(7), 1033-1052.
- □ Wilde, A.R., **Kreuzer, O.P.** (2016). Crowdsourcing–rush to find gold in data. Mining Journal, March 25 to April 07, 2016, pp. 45-46.
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- □ Roshanravan, B., **Kreuzer, O.P.**, Bruce, M., Davis, J., Briggs, M. (2020). Modelling gold potential in the Granites-Tanami Orogen, NT, Australia: A comparative study using continuous and data-driven techniques. Ore Geology Reviews, https://doi.org/10.1016/j.oregeorev.2020.103661.

