

## Tracing Fe-Ti-P-(REE) mineralization in the southern Oslo Rift, Norway: an integrated geochemical and geophysical study

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### ABSTRACT

The growing demand for high-tech applications and sustainable agriculture is driving global interest in critical raw materials such as rare earth elements (REE) and phosphorus (P). REEs are vital for green-energy technologies, and P is essential for fertilizer production. Southern Norway is a glaciated terrain and hosts several P-REE-rich magmatic occurrences, including Europe's largest REE deposit (Fen) and smaller prospects in the southern Oslo Rift (SOR), such as the Kodal deposit. In the SOR, Fe-Ti-P-REE mineralization typically occurs in small, irregular titanomagnetite-apatite-ilmenite-rich lenses, making exploration challenging. A recent mineral potential study identified prospective zones in the SOR, leading to field validation at the Kåsemyrene occurrence. This area served then as a case study to assess the effectiveness of integrating till geochemistry, magnetic susceptibility, and high-resolution drone magnetic surveys for detecting Fe-Ti-P-REE mineralization. Field measurements using a portable XRF and magnetic susceptibility meter were compared with equivalent laboratory analyses to evaluate the time, cost, and quality efficiency. Strong correlations between field and laboratory measurements were found for the elements Ca, P, Fe, Zr, Rb and Sr and magnetic susceptibility. Geochemical (e.g. Ca, Sr, P) and magnetic susceptibility anomalies coincided with a drone-identified magnetic high that is linked to mineralization. Dimensionality reduction methods enhanced geochemical anomaly signals by processing information from less dominant but relevant elements (e.g. REEs, Rb). The study demonstrates that integrated, cost-effective field methods can successfully support mineral exploration in glaciated terrains.

### INTRODUCTION

The growth of the high-tech sector and rising environmental pressures on agriculture are driving global demand for critical raw materials, such as rare earth elements (REEs), phosphorus (P), zirconium (Zr), and niobium (Nb). REEs are essential for green technologies—including batteries, solar panels, and electric vehicles—due to their unique properties (e.g. Goodenough et al. 2016). Phosphorus is vital for fertilizers and food security (e.g. Ihlen et al. 2014), and Zr and Nb, high field strength elements (HFSE), are important in the production of advanced industrial materials. However, the limited and uneven global distribution of these elements, along with concentrated processing capacity, presents supply risks. These factors underscore the importance of reassessing Europe's critical mineral resources to ensure long-term supply security and the green and digital transition.

Norway hosts several Fe-Ti-P-Nb-(REE) occurrences, including the Fen deposit (Europe's largest known REE resource). To the east of the Fen deposit, mineralization within intermediate intrusive rocks of the Oslo Rift is gaining attention for its critical metals' potential (Fig. 1A). These rocks show enrichment in Fe, Ti, P, REE, Zr, and Nb (e.g. Mansur et al. 2025). A recent initiative by the Geological Survey of Norway (NGU) has helped evaluate the southern Oslo Rift (SOR) mineral potential, improve ore genetic models, and develop exploration strategies (Coint et al. 2025).

Soil geochemical surveys are key tools in mineral exploration, offering insights into ore-related element dispersion (e.g. Kyser et al. 2015). In Fennoscandia, glacial till, which has been derived from bedrock and transported and deposited by ice, is the dominant parent material on which soil has formed, making it a reliable sampling medium for mineral exploration (McClenaghan and Paulen 2018). Systematic till sampling has proven effective for detecting buried mineralization and has led to discoveries in glaciated regions such as Canada (e.g. Plouffe et al. 2012; McClenaghan et al. 2023).

*continued on page 5*

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December 2025

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## Note from the Editor

Welcome to the fourth EXPLORE issue of 2025. This issue features an article describing the tracing Fe-Ti-P-(REE) mineralization in the southern Oslo Rift, Norway using geochemistry and geophysics. It was written by Pedro Acosta-Gongora, Nolwenn Coint, Iain Henderson, Eduardo Texeira Mansur, Malin Andersson, Florent Sztikar, Mikis van Boeckel, Ana Carolina Rodrigues Miranda, Ying Wang, and Madeline Lee.

EXPLORE thanks all those who contributed to the writing and/or editing of the four issues in 2025, listed in alphabetical order: P. Acosta-Gongora, E. Ambrose, S. Amor, J. Anderson, M. Andersson, M. Arundell, W. Barnes, P.J. Beckett, S. Beyer, M. Brown, P. de Caritat, F. Caron, J. Carranza, M. Charbonneau, N. Coint, S. Cook, J. Graham, I. Henderson, B. Halvorson, J. Kidder, M. Lakanen, D. Layton-Matthews, M. Lee, R. Lett, D. Leng, M. Leybourne, E.T. Mansur, N.R. Mashyanov, Ana Carolina R. Miranda, L. Moore, E. Perkins, P. Rasmussen, J. Rice, A.S. Rukhlov, V.V. Ryzhov, S. Scher, A.D. Shashko, S.E. Sholupov, G. Spiers, F. Sztikar, Y. Uvarova, M. van Boeckel, A. Voinot, Y. Wang, and R. Zuo.

EXPLORE thanks all of the paid advertisers in 2025 for their financial support of the publication of this newsletter.

**Beth McClenaghan**  
EXPLORE Editor

**Steve Cook**  
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## President's Message



Welcome to the last issue of EXPLORE for 2025, I cannot believe how fast this year has gone by! This is my last message to you as AAG President, and I would like to warmly welcome Prof. Renguang Zuo as incoming AAG President to the role.

AAG ran a fantastic booth at the Society of Economic Geologists (SEG) annual event, SEG 2025 Conference, in Brisbane, Australia, in 26–29 September 2025, and promoted the Association, EXPLORE newsletter, and GEEA. The booth was organised by Mark Arundell and Sam Scher, and Brian Townley also assisted to manage it. Many thanks to you, Mark, Sam and Brian! We also appreciated Mark Pirlo, Mike Whitbread, Iain Dalrymple, Steve Cook, Alan Koenig, Ryan Noble, and others dropping by, and Mark Pirlo's help with merchandise for the conference. There was a lot of traffic through our booth, and the team was very busy during the session breaks and at the end of the day sessions. If there was a prize for the star of the SEG conference it would be hard to beat the Pro Earth Digital Hand lens. We had 145 entries (~13% of conference attendees) to win the two

DHLs that were given away – kindly donated by Jess Keast from Prospectors/GeoHug. There was a QR code at the booth and people were able to scan the QR code and join or re-join the Association on the spot. Many students visited the booth and were curious to find out about the AAG, this was a very rewarding experience. Overall, it was a successful promotion event for us and shows the value of partnering with our “sister organisations”.

Our own upcoming 31<sup>st</sup> International Applied Geochemistry Symposium (IAGS2026) is shaping up nicely. The website is now live <https://iags2026.cugb.edu.cn/index.htm>! Session and Sponsor Proposals will open on 10 January 2026. Please consider submitting an idea for a scientific session or support the event as a Sponsor.

As always, I would like to remind you about the AAG Medals and consider who of your peers you would like to nominate to celebrate their achievements in the field of geochemistry or recognise dedicated service to the Association!

As we head into a holiday season, I am sending you the best festive seasonal wishes and wishing you a fantastic 2026!

Best wishes,

**Yulia Uvarova**

*Outgoing AAG President*



## Erratum

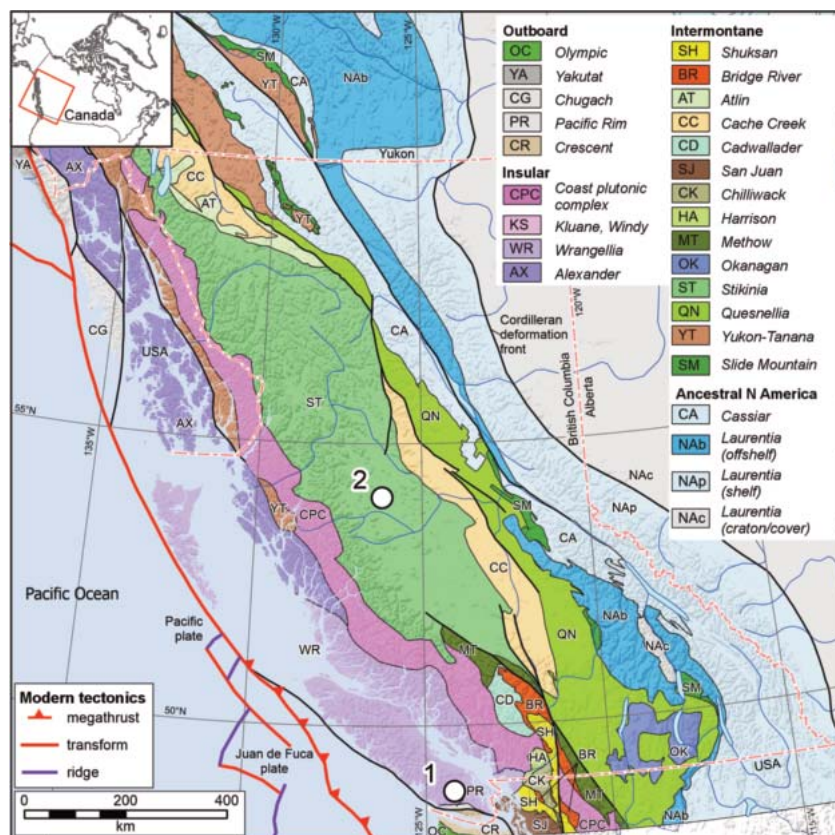


Fig. 7. Air mercury survey sites at mineral occurrences in British Columbia, Canada: 1 - Lara-Coronation, 2 - Silver Hope. Terranes after Colpron (2020).

**Correction of Figure 7 in *New methodology for air mercury surveys over mineralization* by N.R. Mashyanov, A.S. Rukhlov, S.E. Sholupov, V.V. Ryzhov, A.D. Shashko, E. Perkins and W. Barnes. EXPLORE, 208, p. 13.**

In the original article, Figure 7 on page 13 was presented with a portion of the ocean mask reproduced incorrectly. This error may affect the interpretation of the data presented in the figure.

The conclusions of the paper remain unchanged. The Editor sincerely apologizes for this error and any confusion it may have caused.

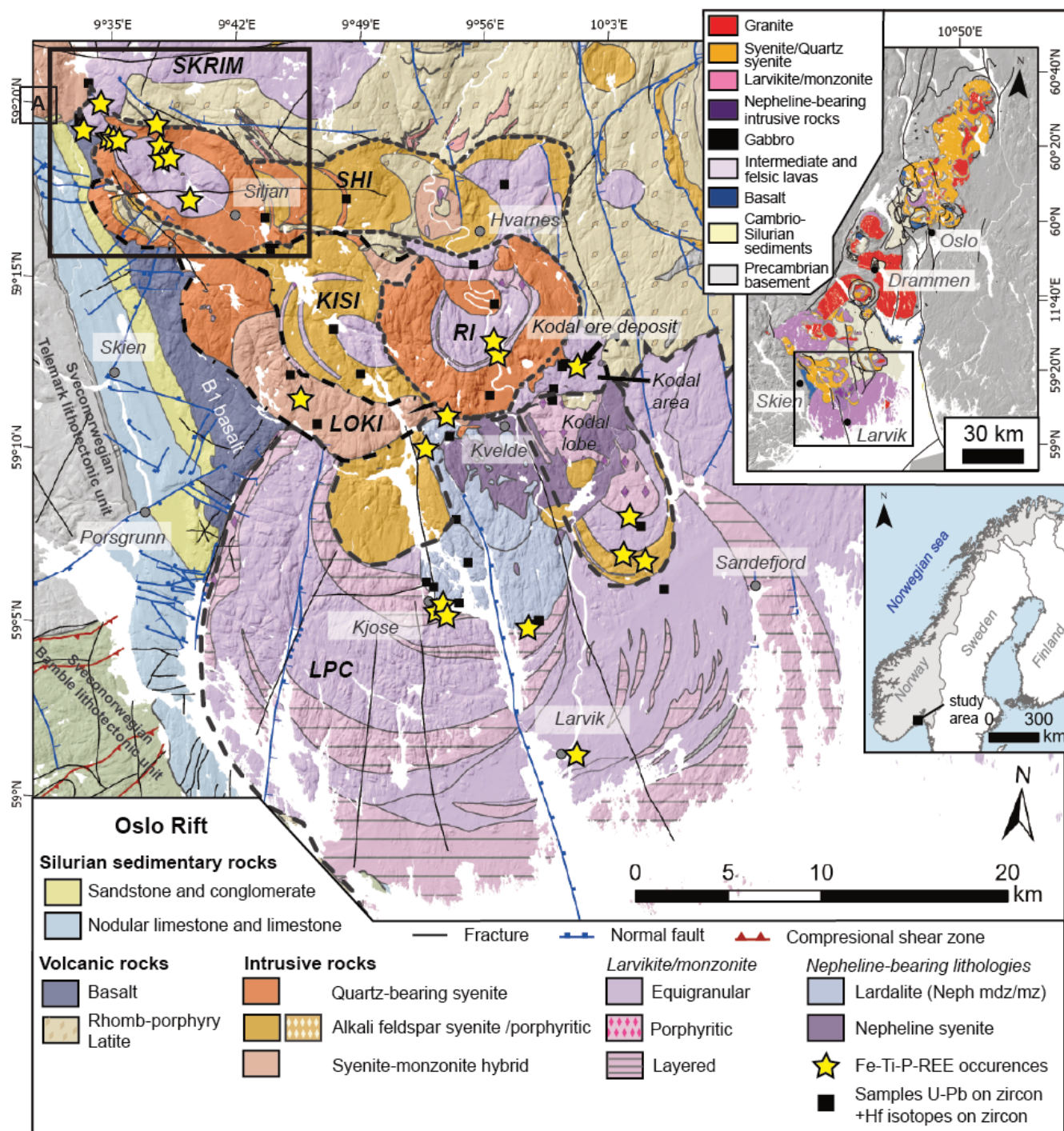
The online version of the article has been corrected to include this corrected version and is reproduced here for reference..



## Tracing Fe-Ti-P-(REE) mineralization in the southern Oslo Rift, Norway *continued from page 1*

Recently, Unmanned Aerial Vehicles (UAVs) with magnetic sensors have improved resolution and coverage in airborne geophysical surveys, enabling the detection of subtle anomalies associated with mineralized zones. This drone technology enhances early-stage exploration, especially in areas with remote access, challenging terrain and/or where bedrock outcrops are limited (i.e. vegetated areas).

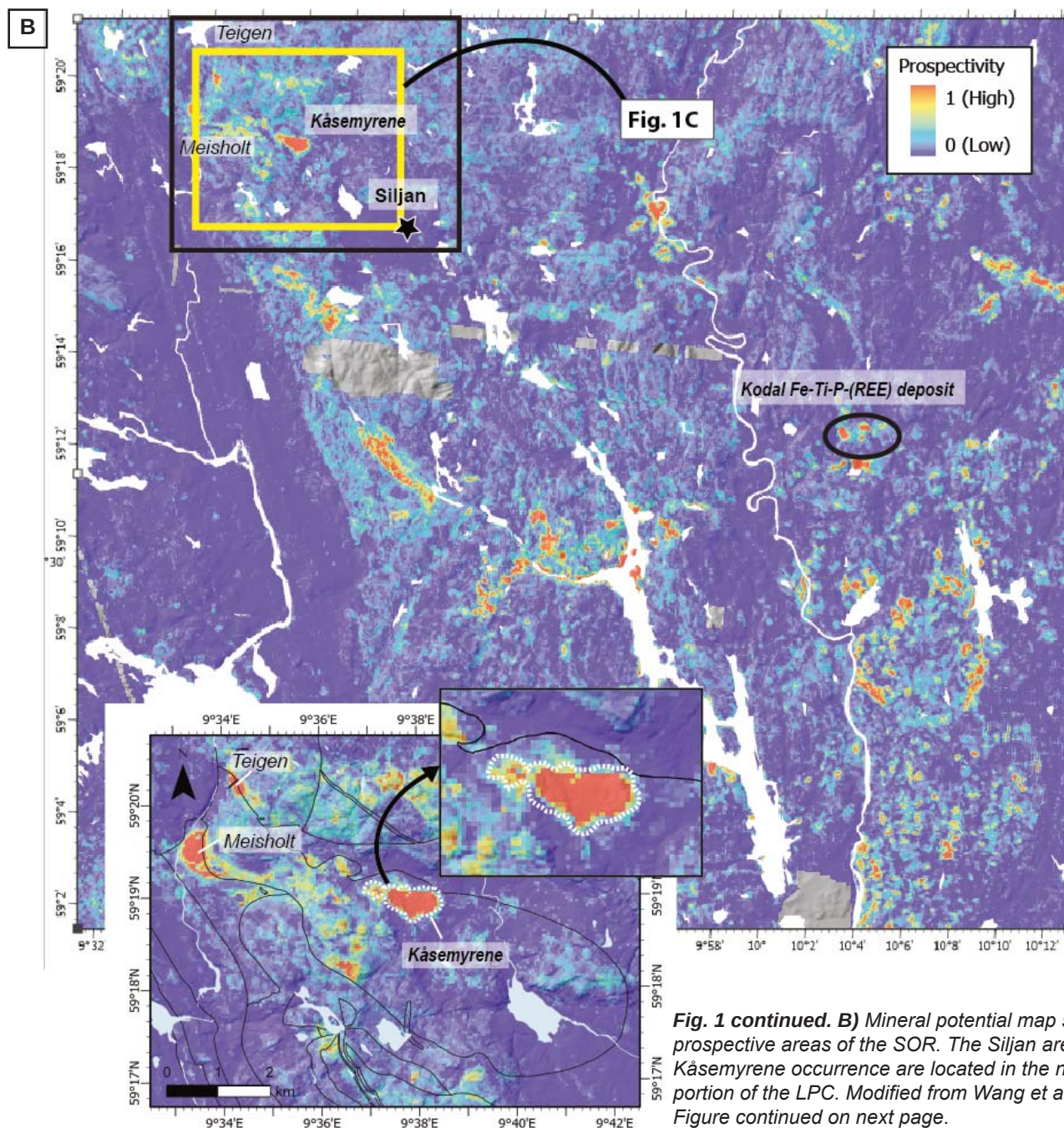
The Kåsemyrene occurrence, located in the Siljan area (Fig. 1A, B), is host to several targets identified by NGU's mineral potential study (Wang et al. 2024; Fig. 1B) and was selected for field validation. This study evaluates the combined use of soil (till) geochemistry, magnetic susceptibility, and UAV magnetics to detect Fe-Ti-P-(REE) mineralization. This integrated workflow enhances the potential for new discoveries in the Oslo Rift and is applicable to similar systems in glaciated terrains worldwide.



**Fig. 1. A)** Simplified geological map of the SOR and the locations of known Fe-Ti-P-(REE) occurrences. The dark grey dashed lines indicate the delineation of main intrusions. The inset shows the total extent and main rock types of the Oslo Rift. Abbreviations: KISI – Kiste intrusion; LOKI – Løkka intrusion; LPC – Larvik Plutonic Complex; RI – Rimstad intrusion; SHI – Siljan-Hvarnes intrusion; SKRIM – Skrim Larvik. Modified from Mansur et al. (2025). Figure continued on next page.

*continued on page 6*

# Tracing Fe-Ti-P-(REE) mineralization in the southern Oslo Rift, Norway *continued from page 5*



**Fig. 1 continued. B)** Mineral potential map showing prospective areas of the SOR. The Siljan area and Kåsemyrene occurrence are located in the northeastern portion of the LPC. Modified from Wang et al. (2024). Figure continued on next page.

## OSLO RIFT GEOLOGY

The Oslo Rift is a 400 km-long and 60–120 km-wide tectonic zone formed along the southwestern margin of the Baltic Shield (e.g. Larsen et al. 2008; Fig. 1A). It is divided into the Oslo Graben and the submerged Skagerrak Graben. Rift development consisted of six evolutionary stages, beginning with sedimentation of the Asker Group and followed by widespread basaltic volcanism at ca. 300–299 Ma. During the subsequent plateau-lava and rift-valley stage, extensive volcanism produced rhomb-porphyry lavas accompanied by coeval plutonic intrusions. The most prominent of these is the Larvik Plutonic Complex (LPC; Fig. 1A), which comprises monzonite (larvikite), nepheline monzodiorite to syenite (Rämö et al. 2022; Mansur et al. 2025). North of the LPC, the Siljan-Hvarnes intrusion, along with the Skrim larvikite,

*continued on page 8*



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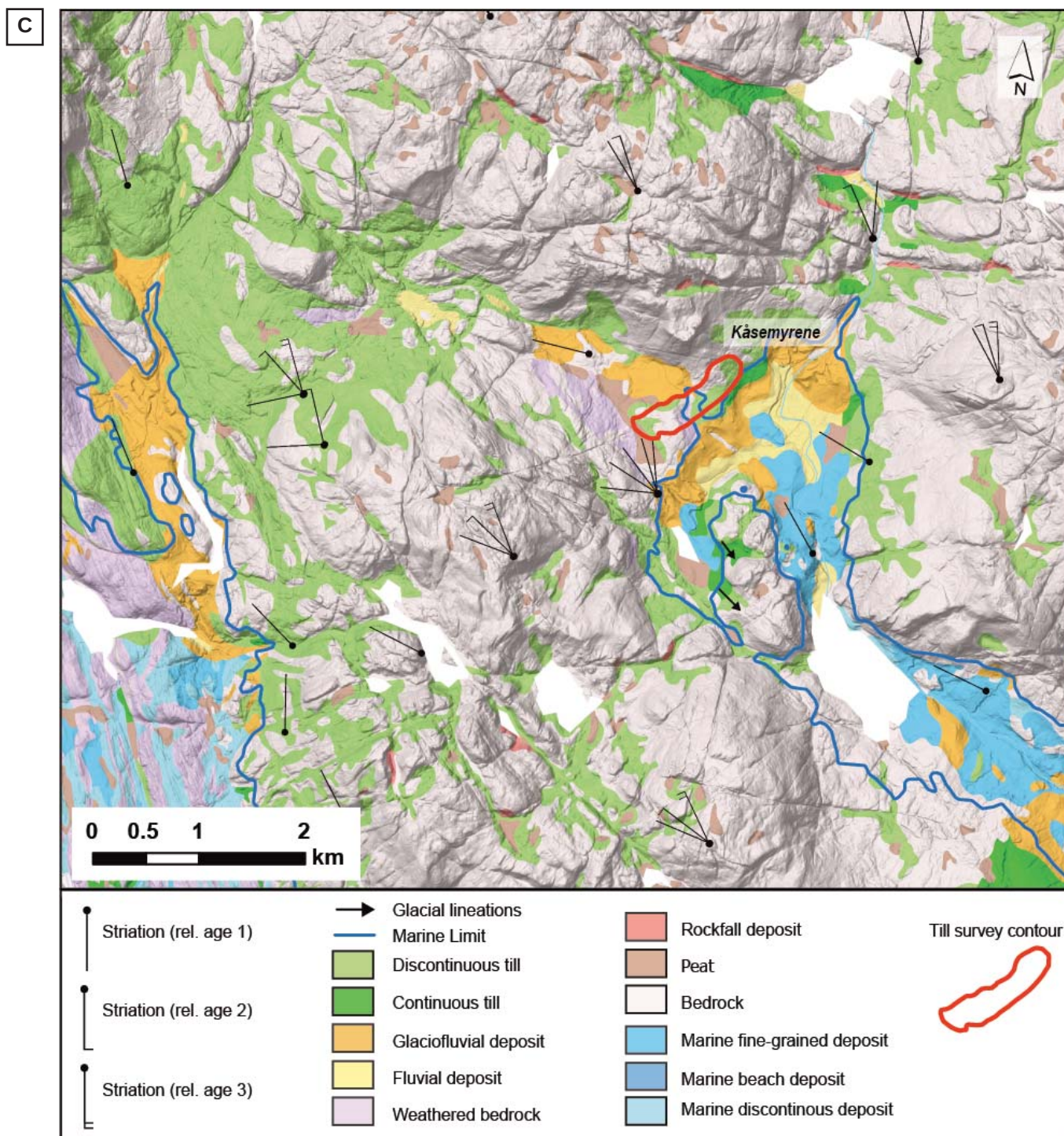
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**Fig. 1 continued. C)** Quaternary geology map of the surveyed area (Geological Survey of Norway 2025).

represents later intrusive activity, with zircon and baddeleyite U-Pb ages indicating progressively younger magmatism from 284 to 278 Ma (e.g. Mansur et al. 2025).

Magmatic rocks from the plateau-lava and rift-valley stage also host Fe-Ti-P-(REE) mineralization, notably the Kodal deposit (e.g. Ihlen et al. 2014). Though poorly exposed, massive nelsonites and magnetite-, apatite-, ilmenite-rich pyroxenites are visible in an old pit area. Drilling by Norsk Hydro and Kodal Minerals (1970s–2010s) revealed a ~2 km-long, 100 m-thick, subvertical, east–west-trending orebody dipping south (Ihlen et al. 2014). Other Fe-Ti-P-(REE) occurrences associated with the LPC and the Siljan-Hvarnes intrusion have also been described by Andersen (2021).

#### SILJAN-HVARNES INTRUSION AND Fe-Ti-P-(REE) MINERALIZATION

The Siljan-Hvarnes intrusion is a 20 km-long, 3–5 km-wide, east–west-trending composite body of monzonite to quartz syenite intrusions (Fig. 2A). The monzonite is typically medium- to coarse-grained, with subhedral to euhedral plagioclase and alkali feldspar, clinopyroxene, and minor biotite, magnetite, and apatite (Fig. 3A). The syenite comprises

Tracing Fe-Ti-P-(REE) mineralization in the southern Oslo Rift, Norway

continued from page 8

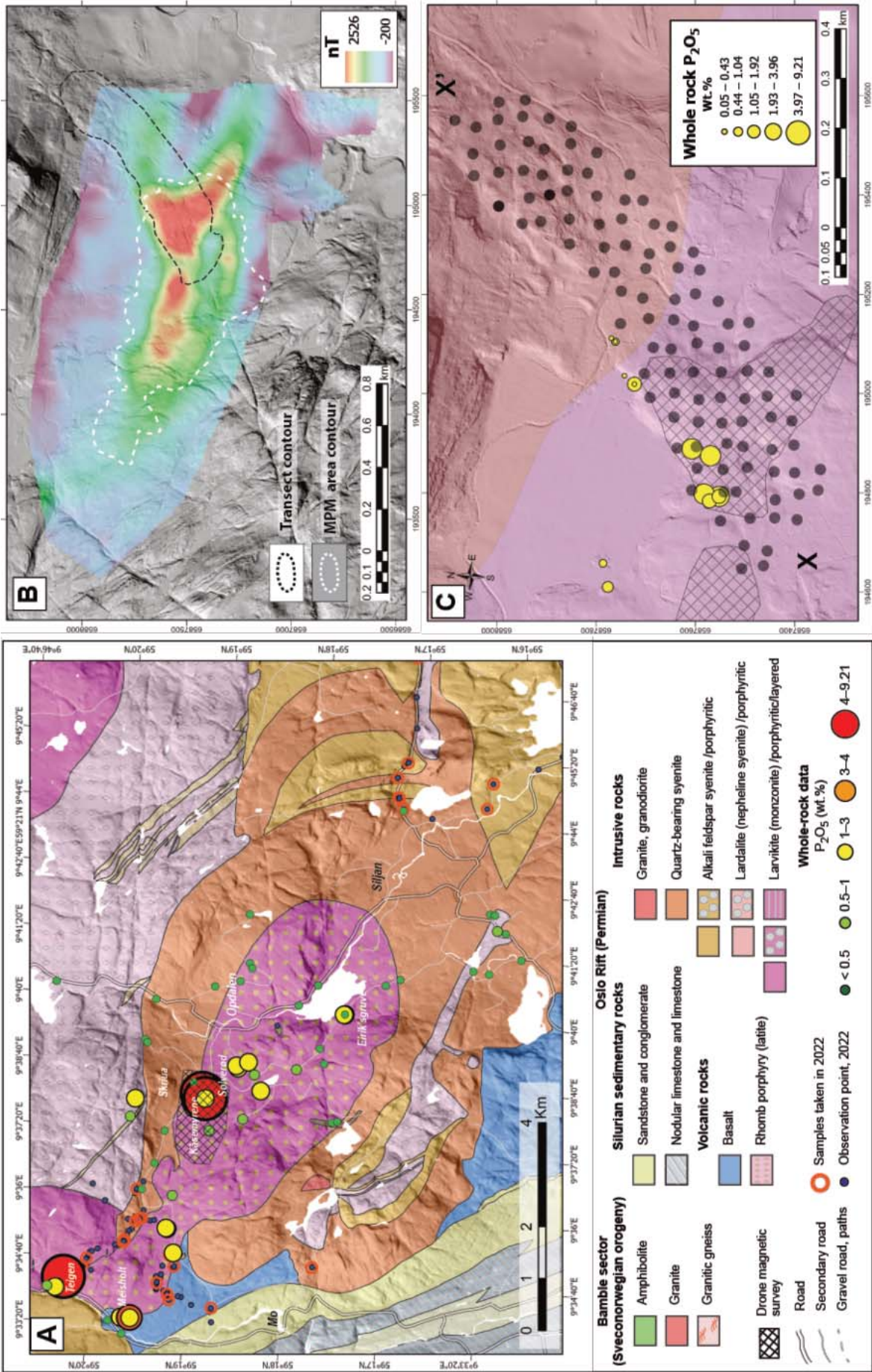
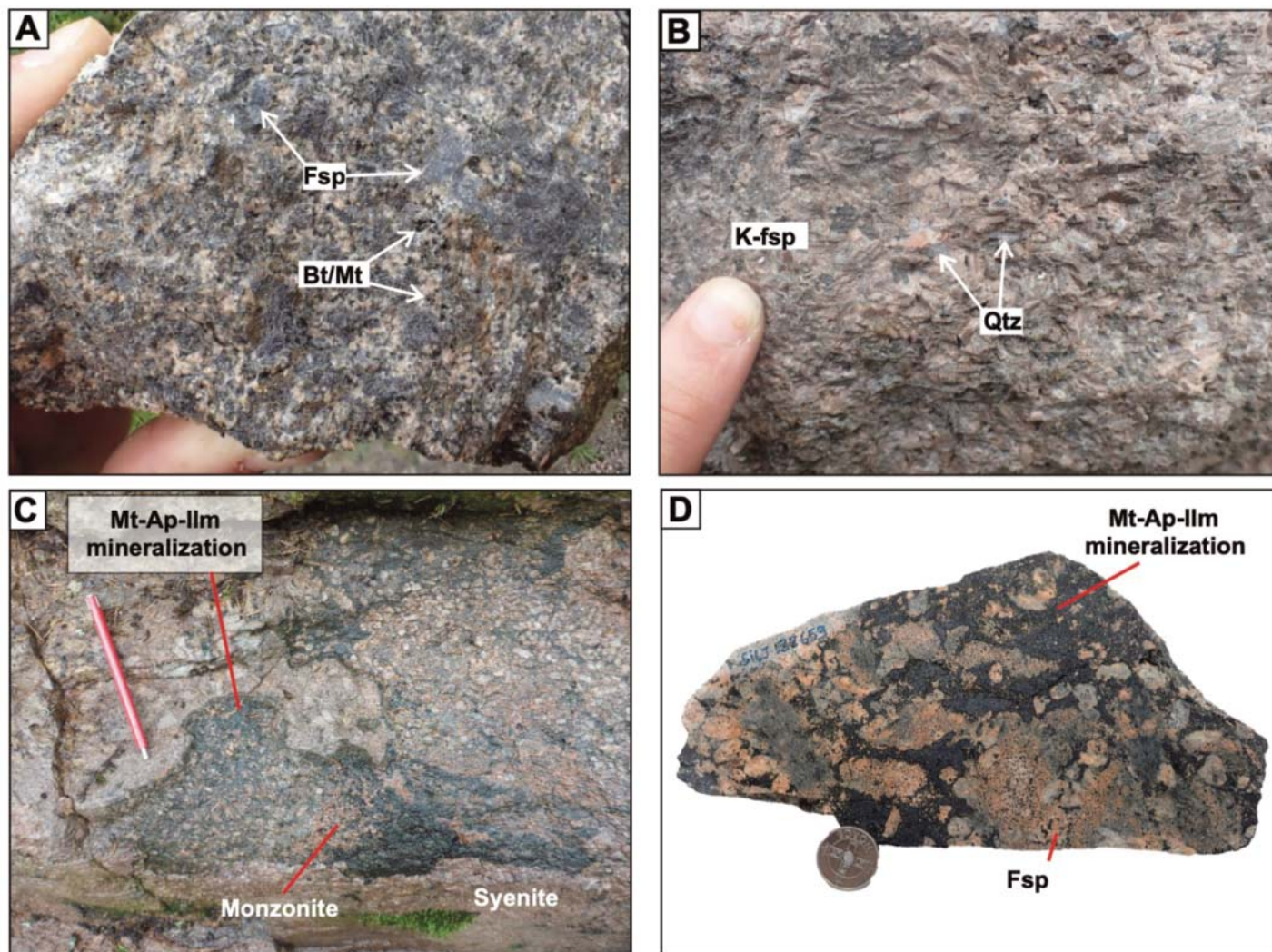


Fig. 2. A) Bedrock geology map of the Siljan area. B) Total field aeromagnetic data for the Kåsemyrene area (drone survey). C) Location of soil samples taken in the Kåsemyrene area and whole rock  $P_2O_5$  (wt. %) data from samples collected from the barren and mineralized areas are shown. The X-X' indicates the trend (N38°E) of profiles presented in figures 7 and 8.

## Tracing Fe-Ti-P-(REE) mineralization in the southern Oslo Rift, Norway

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**Fig. 3.** Unmineralized (A) porphyritic monzonite, and (B) quartz-syenite from the Siljan-Hvarnes intrusion. (C) Fe-Ti-P-(REE) mineralization hosted within fine-grained syenite from the Siljan-Hvarnes intrusion. (D) Relict subeuhedral feldspar crystals floating into fine-grained Fe-Ti-P-(REE) mineralization. Abbreviations: Ap – apatite; Bt – biotite; Fsp – feldspar; Ilm – ilmenite; Mt – magnetite; Qtz – quartz.

medium-grained alkali feldspar with interstitial biotite and quartz (Fig. 3B). Fe-Ti-P-(REE) mineralization commonly occurs in mingling zones between lithologies of contrasting grain size, particularly between fine-grained syenite and coarse-grained monzonite (Fig. 3C, D). Mineralization occurs as massive to metre- or centimetre-scale pockets rich in titanomagnetite, apatite (host to P and REE), ilmenite, clinopyroxene, Ti-rich Ca-amphibole and/or biotite, irregularly distributed (i.e. discontinuous outcrops) within <1 km<sup>2</sup> areas hosted by monzonite or syenite (Fig. 3C, D).

As part of a regional mineral potential mapping study, Wang et al. (2024) identified three key areas within the Siljan-Hvarnes intrusion as promising exploration targets: the Kåsemyrene (MPM), Teigen, and Meisholt occurrences (Fig. 1B). However, exploration in the Siljan-Hvarnes region—and in the SOR more broadly—faces significant challenges. These include the irregular, spatially constrained nature of Fe-Ti-P-(REE) mineralization and the glaciated terrain. The ice-flow direction and glacial transport in the Siljan area remain poorly constrained, limiting the ability to assess secondary dispersion and complicating efforts to trace mineralized material to its source.

#### SURFICIAL GEOLOGY

In the Oslo Rift region, glacial till deposits are generally discontinuous and limited in extent (Fig. 1C). Bedrock

continued on page 11

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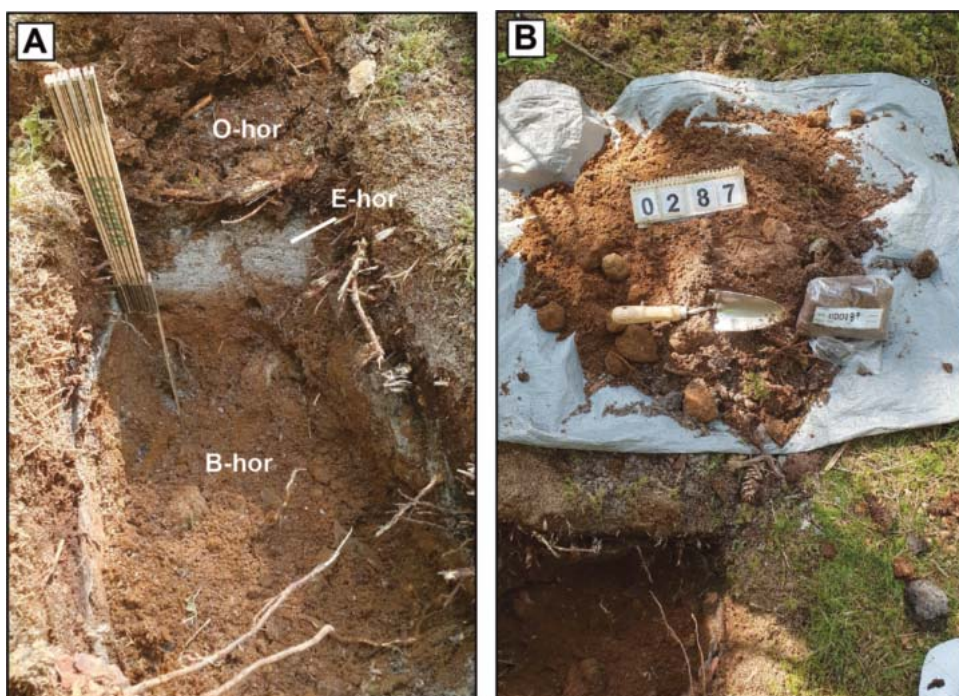
dominates topographic highs at both regional and local scales. The survey area is likewise mapped as discontinuous till, and thus bedrock is exposed or lies close to the surface (Fig. 1C). In the field, it was noted that the till thickness was usually <1.5 m, where often bedrock was observed at the bottom of the sample pits. The typical till weathering profile consists of an organic-rich O-horizon, often present at the surface, underlain by a 2–5 cm bleached E-horizon formed through leaching. Below this, an oxidized, orange-coloured B-horizon reflects iron accumulation (Fig. 4A, B). In some places, the sequence is underlain by relatively unaltered grey C-horizon till, which preserves the characteristics of the glacial parent material.

Glacial striations preserved on bedrock outcrops indicate a shift in ice-flow direction from an earlier southward orientation (relative age 3) to a later southeast trend (relative age 1). This transition is consistent with the pattern of deglaciation (Fig. 1C), in which the Oslofjord–Skagerrak area became ice-free earlier than the more persistent grounded ice in southern Norway's interior (Romundset et al. 2025).

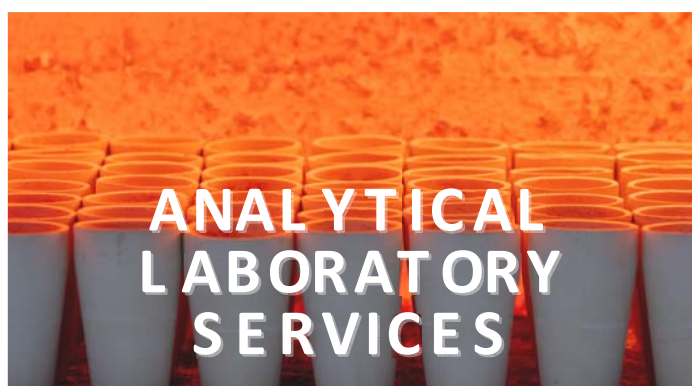
### METHODS

In the following section, we summarize laboratory and field procedures carried out for the acquisition of soil geochemical and magnetic susceptibility data, as well as for a UAV magnetic survey. A comprehensive description of the methods can be found in Coint et al. (2025). The Kåsemyrene occurrence was selected for a ~1 km-long NE-trending transect with a 50 × 50 m sampling resolution, designed to traverse both inside and outside the highly prospective zone indicated by the regional MPM (Fig. 1B; 2B, C). The transect included a soil sampling survey targeting the B-horizon that has developed exclusively on areas covered by till (moraine) deposits (Fig. 4) at approximately 0.2–0.4 m depth. Soil samples were analyzed to determine major and trace elements, along with magnetic susceptibility measurements. In addition to evaluating the effectiveness of these methods for detecting mineralization, the survey aimed to assess the cost and time efficiency of field versus laboratory workflows for future exploration surveys. Field measurements were conducted directly on the collected, variably wet unsieved material (with pebbles removed), whereas laboratory analyses were performed on dried samples sieved to a grain size of <2 mm.

Major and trace element concentrations were measured in the field using a Niton XL5 portable XRF analyzer. Laboratory analyses were conducted at NGU facilities. Major



**Fig. 4.** Photographs of (A) the typical profile of a soil sampling pit showing O-, E- and B-horizons (hor) and (B) the till material (B-horizon) sampled in this survey. Rukhlov et al. 2021).



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and trace elements were measured on the <2 mm soil fraction using lithium tetraborate fusion pellets analyzed by XRF and LA-ICP-MS, respectively. Field magnetic susceptibility of the soil samples was measured using an SM30 meter (ZH Instruments). Corresponding laboratory measurements were performed on the dried, sieved soil samples—also used for geochemical analysis—using a Bartington MS3 system with an MS2K sensor.

The drone survey covered an area of approximately 8 km<sup>2</sup> (Fig. 2B) and was carried out using a DJI M300 RTK multipurpose drone equipped with a Sensys three-axis fluxgate magnetometer. The sensor was attached to the body of the drone as it is not feasible to suspend it beneath it (like in helicopter surveys) due to instability and payload constraints (see details in Coint et al. 2025). The drone was flown N–S at 35 m altitude and 3 m/s, covered 200 km with 5 ms magnetic data acquisition. The resulting total field magnetic map has a resolution of 10 m x 10 m. The raw geophysical and geochemical data are publicly available at <https://www.ngu.no/>.

The geochemical and magnetic susceptibility data were evaluated through inspection of individual variables (elements), application of two dimensionality-reduction techniques, Robust Principal Component Analysis (RPCA), and Uniform Manifold Approximation and Projection (UMAP; McInnes et al. 2018), and definition of anomaly thresholds using the Concentration-Area (C-A) fractal method (Cheng et al. 1994; Sadeghi 2024).

## RESULTS AND DISCUSSION

### Field versus laboratory measurements

Figure 5 shows the co-variation of selected elements quantified both in the field and at NGU facilities (see summary in Table 1). Raw concentrations were transformed to centre log-ratios to reduce spurious correlations caused by the compositional (closed) nature of the data. Major elements, such as Fe, Ca, P, Al, and Si, display moderate to high Pearson correlation coefficients (Pcc), ranging from 0.62 to 0.82 (Fig. 5A–C; Table 1), with Al and Ca showing the lowest and highest values, respectively (Table 1). In contrast, trace elements exhibit more variable behaviour and can be divided into two groups: group 1 (Nb, Ba, Zr, Sr, and Rb), which shows moderate to strong correlations (Pcc = 0.55–0.86; Fig. 5D, E; Table 1), and group 2 (Nd, Pr, Ce, and La), which displays weak correlations (Pcc = 0.18–0.46) (Table 1). Rare earth elements (REEs) are contained in the second group, and achieve low correlation coefficients, with Rb and Sr from group 1 yielding the highest correlations (>0.80). Magnetic susceptibility measurements exhibit the strongest correlation of all variables, with a Pcc of 0.95 (Fig. 5F; Table 1). Overall, the results suggest that most variables—except for the REEs—show good agreement between field and laboratory measurements.

**Table 1.** Pearson correlation coefficients (cc) for field and laboratory measurements.

| Element                 | Pearson cc* |
|-------------------------|-------------|
| Pr                      | 0.18        |
| Nd                      | 0.30        |
| La                      | 0.40        |
| Ce                      | 0.47        |
| Nb                      | 0.55        |
| Al                      | 0.62        |
| Zr                      | 0.65        |
| Si                      | 0.67        |
| Ba                      | 0.70        |
| P                       | 0.78        |
| Fe                      | 0.82        |
| Ca                      | 0.85        |
| Sr                      | 0.85        |
| Rb                      | 0.86        |
| Magnetic susceptibility | 0.95        |

\*using centred log-ratio (clr) transformed data

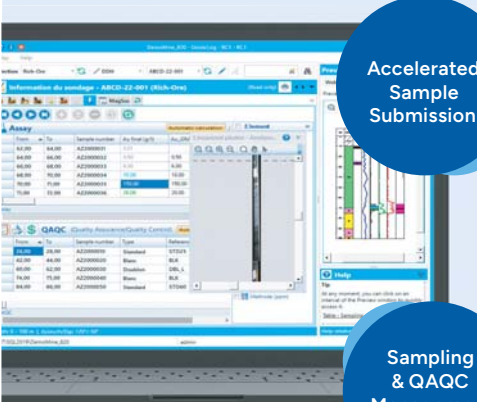
*continued on page 13*

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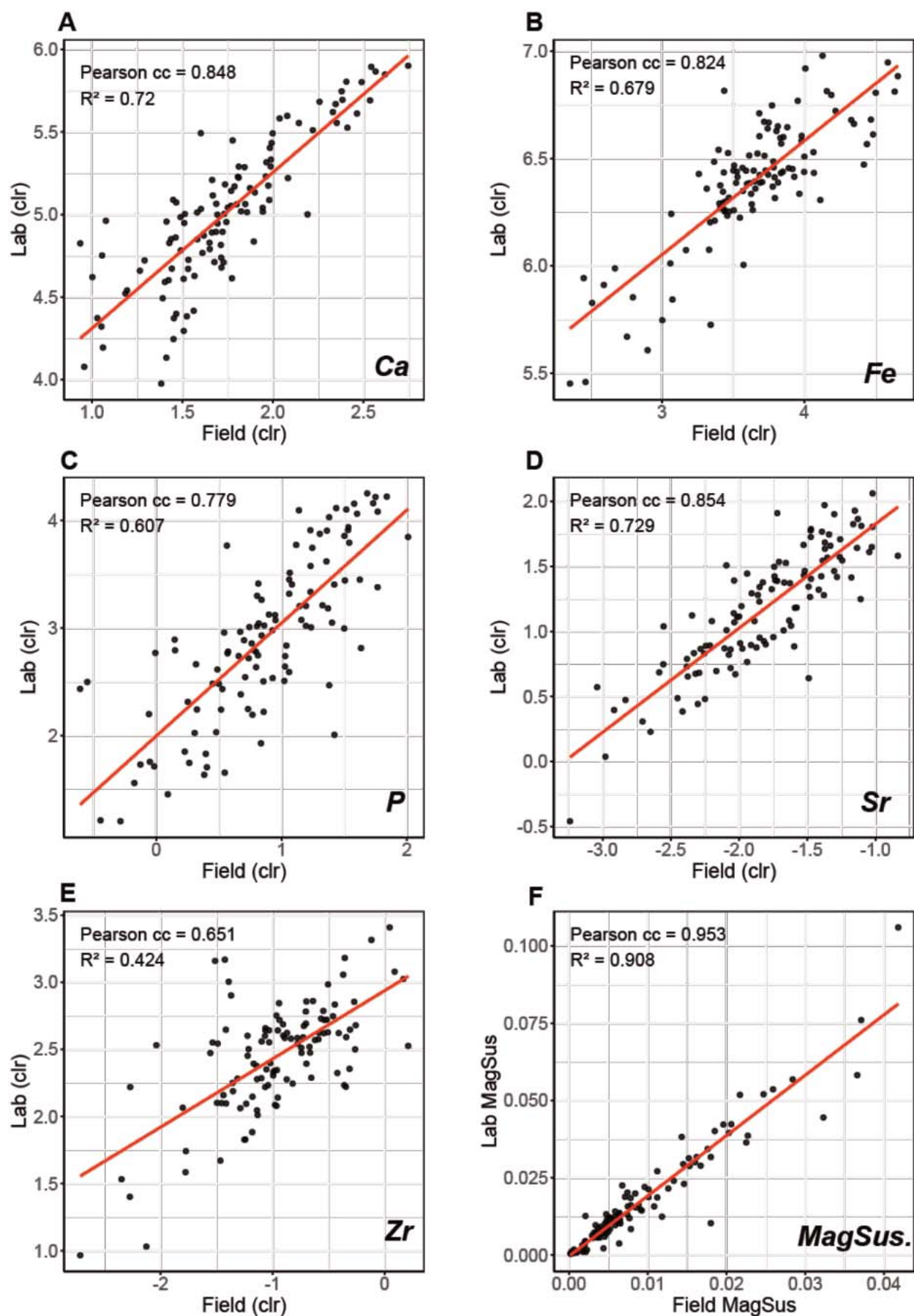
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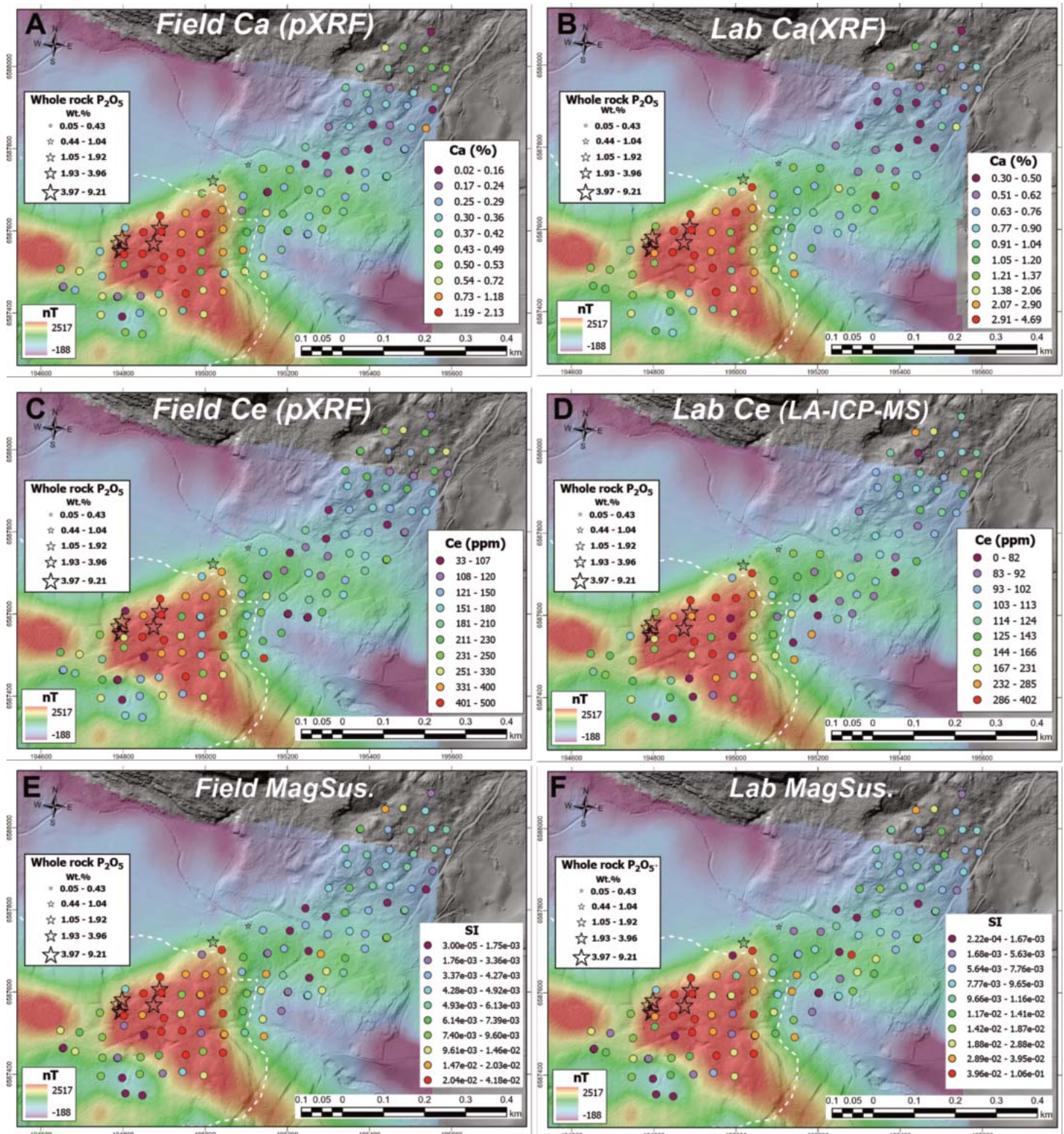
# Tracing Fe-Ti-P-(REE) mineralization in the southern Oslo Rift, Norway *continued from page 12*



**Fig. 5.** Scatterplots of selected elements showing the correlation between field and lab measurements carried out at NGU facilities. Abbreviation: MagSus – magnetic susceptibility; Pearson cc – Pearson correlation coefficient.

*continued on page 14*

# Tracing Fe-Ti-P-(REE) mineralization in the southern Oslo Rift, Norway *continued from page 13*



**Fig. 6. A–D)** Field (pXRF) and laboratory (XRF/LA-ICP-MS) results from the geochemical survey for Ca and Ce, and (E, F) magnetic susceptibility (MagSus) contrasted with the drone magnetic survey.

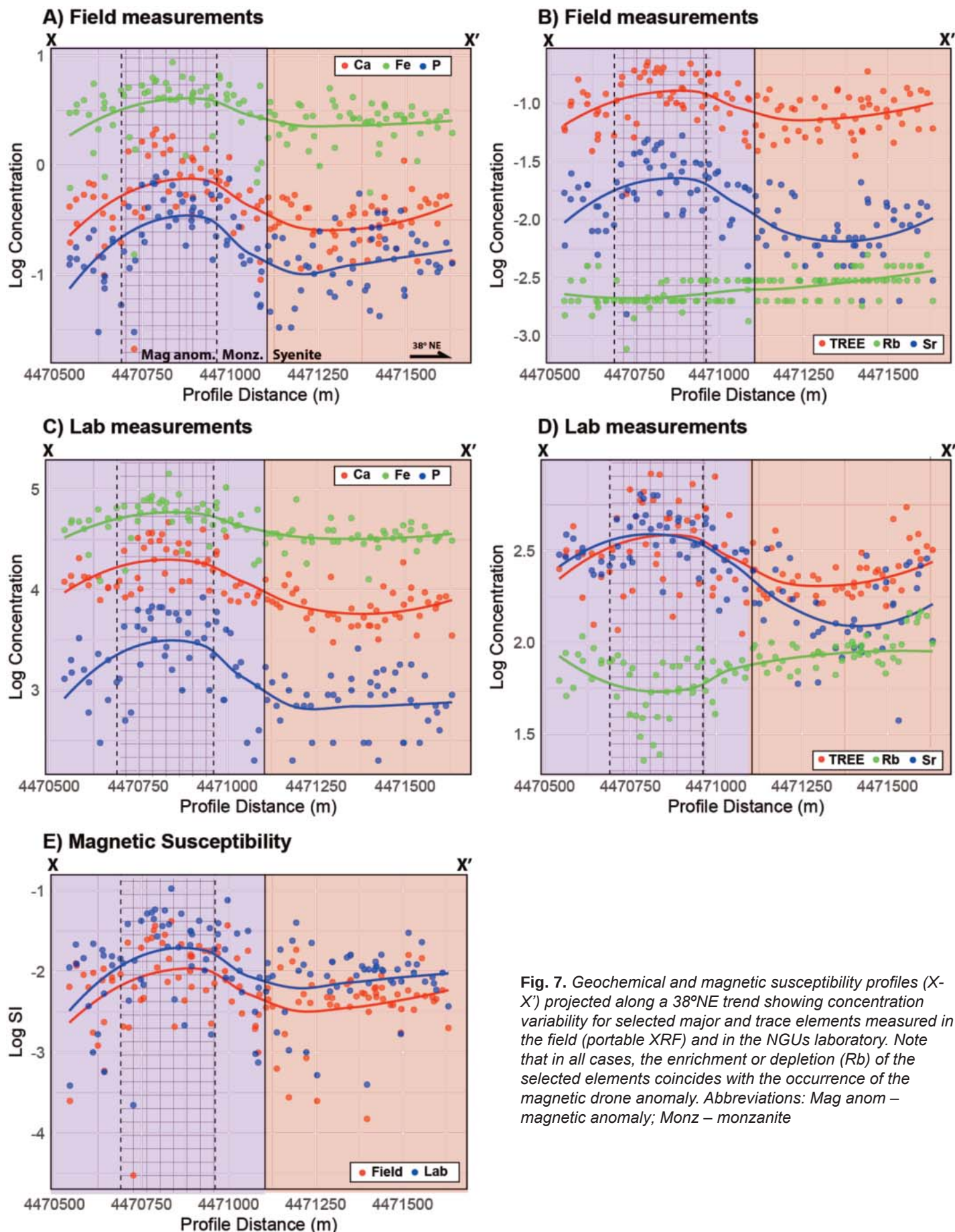
## Spatial context of the geophysical and geochemical data

The higher resolution drone magnetic survey shows that only part of the prospective area, hosted by monzonite, is strongly magnetic, refining the extent of any potentially continuous mineralized body (Fig. 2B). Notably, the magnetic anomaly (the most magnetic rocks; red colour) also coincides with the occurrence of mineralized monzonite (i.e. P-rich rock samples; Fig. 2C).

Figures 6 and 7 present the spatial distributions of selected element concentrations and magnetic susceptibility data from the soil transect, which crosses the eastern part of the main magnetic anomaly. The elements Ca, P, and Sr are at

*continued on page 15*

# Tracing Fe-Ti-P-(REE) mineralization in the southern Oslo Rift, Norway *continued from page 14*



**Fig. 7.** Geochemical and magnetic susceptibility profiles (X-X') projected along a 38°NE trend showing concentration variability for selected major and trace elements measured in the field (portable XRF) and in the NGUs laboratory. Note that in all cases, the enrichment or depletion (Rb) of the selected elements coincides with the occurrence of the magnetic drone anomaly. Abbreviations: Mag anom – magnetic anomaly; Monz – monzonite

## Tracing Fe-Ti-P-(REE) mineralization in the southern Oslo Rift, Norway *continued from page 15*

their highest concentrations at the magnetic high anomaly (Figs. 6A, B; 7A-D). Other variables, such as Fe, REEs and magnetic susceptibility, are also enriched in the same area but the contrast between the high and lower values (Figs. 6C, D; 7B, D, E) is less pronounced. However, Rb concentrations (especially in laboratory data) are depleted over the anomaly (Fig. 7B, D).

Our results suggest that soil composition above the magnetic anomaly is dominated by Ca- and P-rich phases and Fe-bearing magnetic minerals, consistent with the presence of apatite and magnetite, which is typical of the Siljan area. Additionally, the decrease in Rb content reflects replacement by titanomagnetite–apatite–ilmenite mineralization at the expense of primary feldspar. Wang et al. (2024) indicated that the SOR Fe-Ti-P-(REE) mineralization has a distinct geophysical-geochemical signature characterized by low K concentrations (herein Sr is used as a proxy) and is highly magnetic, which, as demonstrated here, is reflected in the overlying till of the Kåsemyrene occurrence. The close spatial compositional correlation between bedrock source and till indicates limited glacial dispersal of mineralization (i.e. relatively in situ material). Taken together, the discontinuous and generally thin nature of till in the Oslo Rift region (Fig. 1C), combined with the restricted dispersal halo, indicates that the sampled till has not been transported far from its source.

### Enhancing the mineralization footprint

Interpreting each element as an independent exploration vector proved effective in tracing Fe-Ti-P-(REE) mineralization to its source. However, this single-variable approach tends to prioritize only a few elements (e.g. Ca, P, Sr) that strongly correlate with the mineralized body (i.e. magnetic anomaly), potentially overlooking valuable information from other less dominant but still important elements such as Fe, REEs, and Rb. To better utilize the full geochemical dataset and enhance the mineralization footprint, two dimensionality reduction techniques were applied: RPCA (Templ et al. 2011) and UMAP (McInnes et al. 2018). Geochemical data were isometric log-ratio transformed before analysis.

Major, trace element, magnetic susceptibility and dimension reduction vector anomalies (Fig. 8A–D) were identified using the (C-A) fractal model (Cheng et al. 1994). Results indicate that both principal component 1 (PC1) and UMAP vector 2 (UMAP2) significantly expand the delineated anomalous area compared to most individual variable anomalies (except for lab-measured Sr), particularly in the field dataset (Fig. 8A, C). Notably, UMAP better separates mineralization from background signals relative to RPCA (Fig. 8E, F), highlighting its potential for improving detection of Fe-Ti-P-(REE) mineralization in future regional and local soil (till geochemical) surveys across the SOR.

### CONCLUSIONS AND IMPLICATIONS FOR MINERAL EXPLORATION

This study demonstrates that soil surveys can effectively detect Fe-Ti-P-(REE) mineralization, as shown at the Kåsemyrene occurrence, where the geochemical anomaly coincides with a magnetic high identified through

*continued on page 17*



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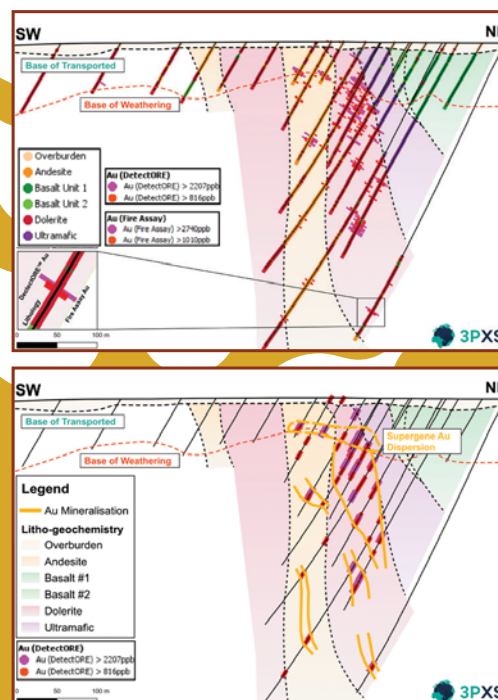
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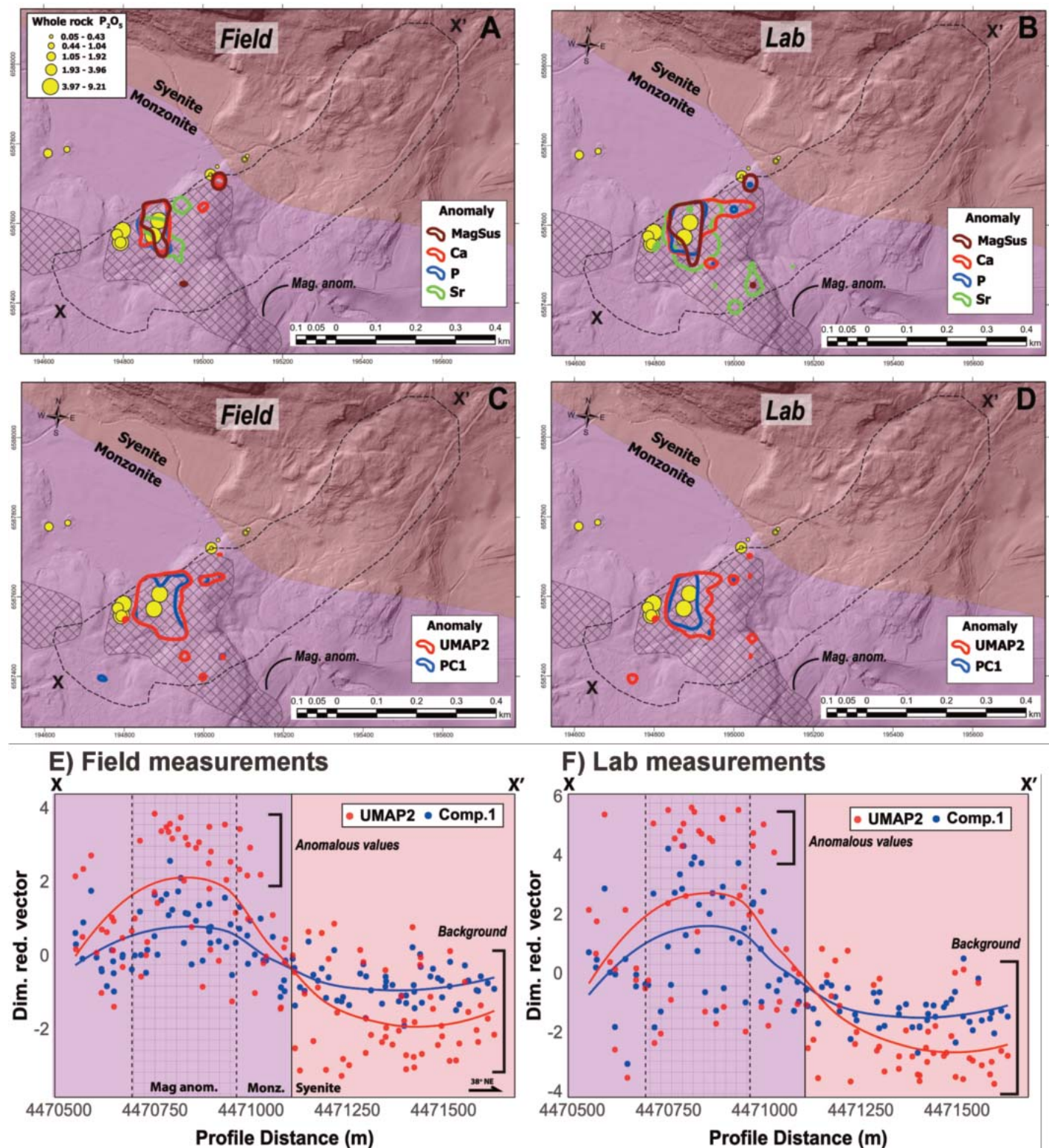
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# Tracing Fe-Ti-P-(REE) mineralization in the southern Oslo Rift, Norway *continued from page 16*



**Fig. 8.** Concentration-Area (C-A) anomalies for selected elements, magnetic susceptibility (MagSus) (A and B), and dimension reduction methods (UMAP and RPCA; C and D) obtained from field and laboratory (lab) measurements. In (E) and (F) are shown vector profiles for RPCA and UMAP. Note how both approaches, but especially UMAP, can further distinguish anomalous from background values and overlap with the drone magnetic anomaly (Mag. anom.). The dashed black line corresponds to the contour of the soil survey.

drone-based mapping. The overlap of these exploration vectors indicates that glacial transport in the area is limited—likely only a few metres. This restricted transport, combined with thin till cover, preserves the geochemical fingerprint of mineralization and makes such surveys a pseudo-in situ approach, particularly effective in vegetated areas such as Kåsemyrene or Kodal. The absence of a dispersal plume means that geochemical anomalies present in the area will not be far from their source.

## Tracing Fe-Ti-P-(REE) mineralization in the southern Oslo Rift, Norway *continued from page 17*

Field and laboratory comparisons further show that portable XRF and SM30 sensors can reliably capture the geochemical signature of mineralization in glacial soils, with moderate to strong correlations. This has important practical implications: field-based measurements are significantly faster and more cost-effective than laboratory analyses. Moreover, the application of multivariate statistics can extend anomaly definition, enhancing the effectiveness of soil surveys at both regional and local scales.

This work highlights a successful multidisciplinary approach—integrating geophysics, geochemistry, and field-based sensing—that can be readily applied to mineral exploration in other glaciated terrains.

### ACKNOWLEDGMENTS

We would like to thank Tokil Sørliø Rhør and Roelant van der Lelij from the NGU laboratory for facilitating the geochemical analyses. We also extend our gratitude to Marina Mahran (University of Liège, Belgium) for conducting the magnetic susceptibility measurements. Finally, we would like to thank reviewers Lyndsay Moore (Geological Survey of Canada) and Beth McClenaghan (EXPLORE Editor) for their insightful comments, which helped strengthen the manuscript.

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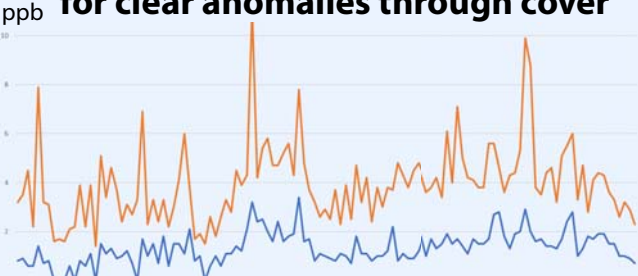
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**10 years ago** EXPLORE 169 (December 2015)

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## News

### 2025 AME Awards Recognize Mineral Exploration Excellence

Long-time member and AAG Fellow, **Barry W. Smee**, has been acknowledged with a 2025 AME Special Tribute for pioneering work in advancing geochemistry that has improved the detection of concealed ore bodies in British Columbia and Yukon, in western Canada. The Association for Mineral Exploration (AME) is the lead association for the mineral exploration and development industry based in British Columbia, Canada. It advocates and promotes the interests of more than 6,000 members who are engaged in mineral exploration and development in BC and globally. The annual AME Awards celebrate remarkable individual and team achievements, contributions and innovation in mineral exploration, and recognize excellence in geoscience, prospecting, financing, social and environmental responsibility, health and safety, innovation and outstanding service to the AME and the mineral exploration and development community in western Canada. Congratulations Barry!



Summarized from: <https://amebc.ca/news/2025-ame-awards-recognize-mineral-exploration-excellence/>

### Short Course: Introduction to Exploration Geochemistry

**Location:** Vancouver, Canada

**Date:** January 24–25, 2026

**Convener:** Dennis Arne, Telemark Geosciences

This comprehensive 2-day short course is designed for geology students, recent graduates and mineral exploration professionals looking for continuing professional development in exploration and applied geochemistry. Day 1 of the course would also be suitable for database professionals wishing to know more about the collection of geochemical data and the assessment of its quality, as well as for more seasoned geologists wishing to review recent advances in the collection, analysis, QA/QC and management of data.

The short course involves PowerPoint presentations to introduce concepts, interspersed with short practical exercises to reinforce some of the strategies and methods. Examples will be drawn from publicly available data sources from Canada and Australia. On completion of the 2-day short course, participants should be able to design, implement and interpret diverse data sets from geochemical exploration programs while ensuring “fit for purpose” data quality and data management.

Participants should bring a laptop to both days of the course and will need to download and install a 2-week trial version of ioGAS software immediately prior to the course. A download link will be circulated prior to commencement of the course. Note that the trial version will not function if it has previously been installed on the machine.



#### **Saturday January 24, 2026: Geochemical Data: Acquisition, Analysis, Quality and Management**

Day 1 of the course covers geochemical sampling strategies, sample preparation and analytical methods, quality assurance and quality control (QA/QC), and basic data management; an A to Z of designing, implementing and reporting geochemical data in compliance with current public reporting codes.

#### **Sunday January 25, 2026: Exploratory Data Analysis using ioGAS**

Day 2 will introduce a structured approach to both univariate and multivariate exploratory data analysis of geochemical data in the best interpretive software available – ioGAS. A key focus of the approach will be the attribution of geochemical data with a variety of metadata for process discovery. No prior use of the software is assumed, as this course will provide a solid introduction.

**Course details and registration information are available at**

<https://roundup.amebc.ca/event/an-introduction-to-exploration-geochemistry/>

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**News** *continued from page 20***Update: Digital Object Identifiers (DOIs) for EXPLORE articles**

The March 2025 issue of EXPLORE was the first new issue to have a DOI registered to its science article. In addition to articles in current and future issues being assigned a DOI, our EXPLORE team has been working diligently behind the scenes to obtain DOIs for previously published science or technical articles that are deemed relevant in past issues. So far, EXPLORE articles back to 2009 (EXPLORE issue 142) have been assigned DOIs.

The expected enhancement in the discoverability of EXPLORE science articles is effective, with hundreds of 'hits' being reported by Crossref each month. The articles which have attracted the most successful resolutions (i.e. views) in the last quarter are as follows:

September 2025: <https://doi.org/10.70499/ZXZS8433>

Title *New methodology for air mercury surveys over mineralization*

Authors: N.R. Mashyanov, A.S. Rukhlov, S.E. Sholupov, V.V. Ryzhov, A.D. Shashko, E. Perkins, and W. Barne

Issue: 208, September 2025

October and November 2025:

<https://doi.org/10.70499/BXDR8533>

Title: *Overview of indicator mineral research at the Geological Survey of Canada – an update*

Authors: M.B. McClenaghan, A. Plouffe, R.C. Paulen, M.G. Houlé, S.E. Jackson and J.M. Peter

Issue: 170, March 2016

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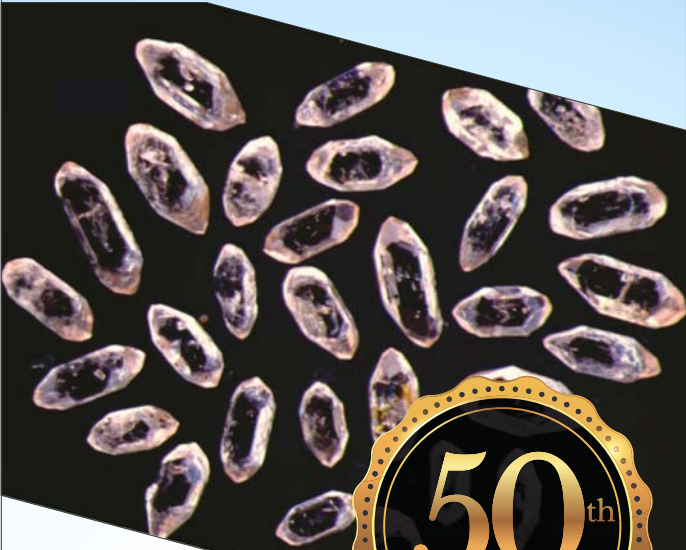
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There are no AAG news items in this issue of ELEMENTS.



**Volume 21, Number 6, October 2025**

***The Variscan Orogeny in Europe – Understanding Supercontinent Formation***

This issue of ELEMENTS conveys the account of the Paleozoic joining of Laurussia and Gondwana to develop Earth's last supercontinent, Pangaea..

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**John Carranza**

## Recently Published *continued from page 21*

### Geochemistry: Exploration, Environment, Analysis

Volume 25, Issue 4, November, 2025

#### Research Article

Advancing exploration hydrogeochemistry using single particle inductively coupled plasma-time-of-flight mass spectrometry at the Bear Lodge alkaline complex, Wyoming, USA

*A.J. Goodman, S. Warix, H-E Ahabchane, M. Hadioui and K.J. Wilkinson*

<https://doi.org/10.1144/geochem2025-032>

#### Thematic collection

**Metal geochemical fingerprinting to identify sub-watershed source contributions to surface water at a regional arid watershed scale, Four Corners Region, USA**

Adaptive instrument design strategy for collecting water, sediment samples and stage data in remote, ephemeral arroyos in the arid southwestern United States

*J.E. Brown, C.A. Van Zante and R. Mixon*

<https://doi.org/10.1144/geochem2024-030>

Evaluating sediment transport and metal sorption in the San Juan River watershed

*M. Whiting, K. Bosch, C. Van Zante, J. Brown, R. Mixon, J. Blake and Z. Ratigan*

<https://doi.org/10.1144/geochem2024-038>

Applying geological unit distribution and chemical weathering indices to evaluate potential lithological sources of Al, As and Pb to the San Juan River, Four Corners region, USA

*C.L. Ferguson, J.M. Blake, C.A. Van Zante, R. Mixon and D. Yager*

<https://doi.org/10.1144/geochem2024-035>

Morphometric and geological characterization with statistical correlations for 33 tributary drainage basins of the San Juan River watershed in the Four Corners region, USA

*K.E. Bosch, Z. Shephard, R. Mixon, J.M. Blake, S. Chavarria and D.B. Yager*

<https://doi.org/10.1144/geochem2024-037>

Long-term monitoring of irrigation ditch sediment metal(loid)s in the Animas and San Juan River watershed, New Mexico (USA) after the Gold King Mine spill

*G. Jha, M. Whiting, S. Fullen, A.L. Ulery, K. Lombard,*

*D. VanLeeuwen, C. Brungard and B. Francis*

<https://doi.org/10.1144/geochem2024-041>

Tracking the sources of metals to the San Juan River, Four Corners Region, USA: an introduction to the thematic collection

*J.M. Blake, S.A. Austin, F. Johnson, J. Brown, S. Chavarria,*

*R. Mixon, C.A. Van Zante, K. Wilkins, M. Whiting,*

*C.L. Ferguson, Z. Shephard, K. Bosch, T. Austring,*

*Z. Ratigan, A. Shomour and D. Yager*

<https://doi.org/10.1144/geochem2024-027>

Identifying the sources of elevated uranium in surface waters within watersheds of tributaries to the San Juan River, Four Corners region, USA

*R. Mixon and J.M. Blake*

<https://doi.org/10.1144/geochem2024-032>

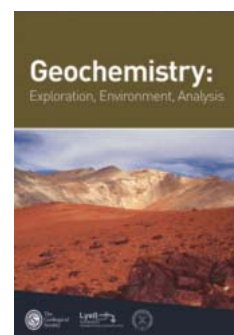
#### Thematic collection

**Biogeochemical methods in mineral exploration: a dedication to Colin Dunn**

Biogeochemical mapping of the Cobar Basin using the needles of cypress pine (*Callitris glaucophylla*)

*J.A.A. Schifano, D.R. Cohen and N.F. Rutherford*

<https://doi.org/10.1144/geochem2025-024>



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## Welcome New AAG Members

### REGULAR MEMBERS

Regular Members are non-voting members of the Association and are currently engaged in the field of applied geochemistry at the time of their application and have been active for at least two years prior to the date of joining.

|                       |                                   |
|-----------------------|-----------------------------------|
| <b>Jonathon Hoyer</b> | <b>Dr. Brian McNulty</b>          |
| Evolution Mining –    | Postdoctoral Fellow               |
| Orebody Knowledge     | University of British Columbia    |
| 5 Kerr Place          | 2204 Main Mall Vancouver ESB 2020 |
| Orange, NWS 2800      | Vancouver, British Columbia       |
| Australia             | V6T 1Z4                           |
| Membership #4599      | Canada                            |
|                       | Membership #4600                  |

### FELLOWS

Fellows are voting members of the Association and are actively engaged in the field of applied geochemistry. They are Regular AAG Members who are nominated to be a Fellow by a Fellow of the Association by completing the Nominating Sponsor's Form. Consider becoming a Fellow of the AAG.

**Ivan Schroder**  
Senior Geologist  
Geoscience Australia  
101 Jerrabomberra Drive  
Symonston, ACT 2609  
Australia  
Membership #4598

### STUDENT MEMBERS

The Association also has student memberships. These members are students who are enrolled in an approved course of instruction or training in a field of pure or applied science at a recognized institution.

**Hernah-Maree Wally**  
University of Papua New Guinea  
Papua, New Guinea  
NCD 121  
Membership #4601



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Applied Geochemists**

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## CALL FOR AAG MEDAL NOMINATIONS

Significant contributions to applied geochemistry or service to AAG are recognised by award of either the AAG Gold or Past Presidents' (Silver) medals respectively. The history of how the medals came about and the formulation of guidelines for their award are discussed in the April 1992 issue of EXPLORE, issue 75, which can be found on the AAG website under Publications/EXPLORE newsletter/1990–1994.

Guidelines for nominating individuals for either medal are posted in 'The Association' section of the AAG website ([www.appliedgeochemists.org](http://www.appliedgeochemists.org)) under the 'Awards' area. Past discussions of the guidelines indicated that the process for nominating individuals for either medal was a little cumbersome, to the extent that some nominations were not being made, and others took an unnecessarily long time to resolve. With this in mind, the 2012–2013 Awards & Medals Committee (Chair: Paul Morris. Committee members Eion Cameron, Pertti Sarala, and Chris Benn) revisited the guidelines to make the nomination process a little friendlier, with a more concise time frame for resolution. The revised guidelines for nominations are presented below.

### 3.0 NOMINATIONS

- 3.1 To be eligible for consideration for either award, nominations must be received by the Chairman of the Awards and Medals Committee on or before December 1<sup>st</sup> of any year.
- 3.2 For acceptance by the Awards and Medals Committee, nominations must be signed by a minimum of four (4) Fellows (voting members) of the Association in good standing.  
Nominations should include the following:
  - (a) A one-page recommendation from each of the four nominators;
  - (b) A resume or curriculum vitae of the nominee;
  - (c) An itemized list of the outstanding scientific achievements (Gold Medal) or the dedicated service to the Association (Silver Medal) of the nominee (maximum two pages).

Since members of the Awards Committee may not have personal knowledge of the nominee, the completeness and quality of the nomination will be critical in terms of evaluation and selection.

Nominations for either medal can be made any time to [ejmcarranza@gmail.com](mailto:ejmcarranza@gmail.com) and will be considered in the year of the nomination provided they are received prior to December 1.

**John Carranza**  
AAG Past President  
Chair, Awards and Medals Committee



## IGAS 2026 Call for Proposals for Conference Sessions, Workshops and Short Courses

The 31<sup>st</sup> International Applied Geochemistry Symposium (IGAS 2026) will be held in Beijing, China, from September 12 to 16, 2026. The IGAS 2026 has the theme "Data-driven geochemical data mining in support of mineral exploration and environmental studies". This symposium will showcase recent advances in data analytics, AI, and geochemical interpretation that are transforming the fields of mineral exploration and environmental geoscience.

IGAS 2026 is now calling for proposals for conference sessions, workshops, and short courses, and we warmly encourage all interested researchers to submit their topics.

### Online Submission Instructions

Applicants should register an account in the online submission system and complete their application through the platform. Please click the corresponding application entry, log in to the official conference website as instructed, and download the application template. After filling in the required information, upload the completed materials in Word or PDF format.

The file name should follow the format: "Thematic Topic Name – First Convener's Name – Affiliation."

The application template can be downloaded from the Download Zone or directly from the application entry.

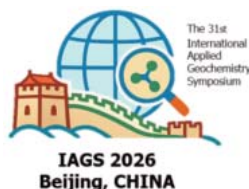
For more details, please visit: <https://iags2026.cugb.edu.cn/Session/TopicApplication/index.htm>

**Submission Deadline: January 31, 2026 (Beijing Time)**

If you have any questions, please contact:

Dr. Zhenjie Zhang, [iags2026@163.com](mailto:iags2026@163.com)

IGAS 2026 Local Organization Committee




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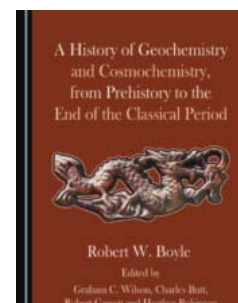
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## A History of Geochemistry and Cosmochemistry, from Prehistory to the End of the Classical Period

Since Mendeleev outlined the modern periodic table in 1869, many new uses have been found for the 92 naturally occurring elements. This book travels back in time to describe the utilization of materials familiar (gold, copper, iron) and arcane (arsenic, boron, red ochre) and their practical history (mining, metallurgy, and crafts), with evidence from archaeology and geology. Together with the technological developments, author Robert Boyle portrays the advances in our understanding of materials science which led to modern geological and environmental sciences. It is a source book valuable to students of history and archaeology, mining and metallurgy, as well as to geologists, mineralogists and geochemists everywhere.

### About the author, Bob Boyle (1920–2003)

Bob was a pioneer of the application of geochemistry to mining geology and mineral exploration. He was an eminent geochemist with a long career at the Geological Survey of Canada where he initiated the Geological Survey of Canada's regional geochemistry program in 1957. His publications spanned various mineral-deposit types and a wide spectrum of precious and base metals. Bob was a founding member of the Association of the Applied Geochemists in the 1970s, and was awarded the Association's highest honor, the Gold Medal, in 1999 in recognition of his lifetime of outstanding achievement in exploration geochemistry. Among Bob's many achievements and awards was his induction into the Canadian Mining Hall of Fame in 1997.



The book is available at: <https://www.cambridgescholars.com/product/978-1-5275-7614-8>

## Free Publications Available from the Association of Applied Geochemists' Website

### Writing Geochemical Reports, 3<sup>rd</sup> Edition

#### Guidelines for surficial geochemical surveys

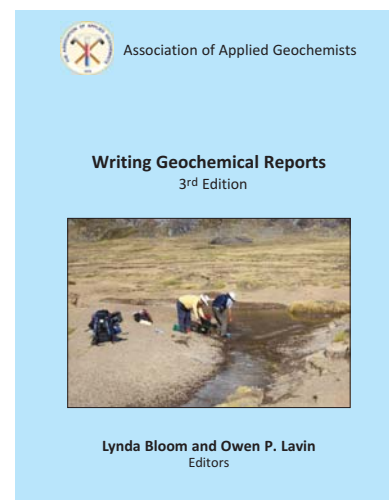
Edited by Lynda Bloom and Owen Lavin

The Association of Applied Geochemists has developed international standards for writing geochemical reports that provide clear instructions for reporting geochemical results, together with the requisite supporting information to evaluate these results for accuracy, integrity and credibility.

The target audience for these guidelines is anyone charged with reporting geochemical results, which includes, but is not limited to, company geoscientists, external consultants and contractors, government scientists, and university scientists and students. The guidelines focus on preparation of an electronic publication that provides a systematic and permanent record of the work performed and take into account the ability to bundle text, tables, figures, images, and oversized maps into one electronic file. The third edition of this guide was released in 2022 and expands the original mandate of Writing Geochemical Reports (1st and 2nd editions) to include multiple types of geochemical surveys with survey-specific recommendations.

The guide may be downloaded free of charge from the AAG website:

<https://www.appliedgeochemists.org/publications>



### Barringer

#### Back to the Future: Airborne Geochemistry and many Related Topics

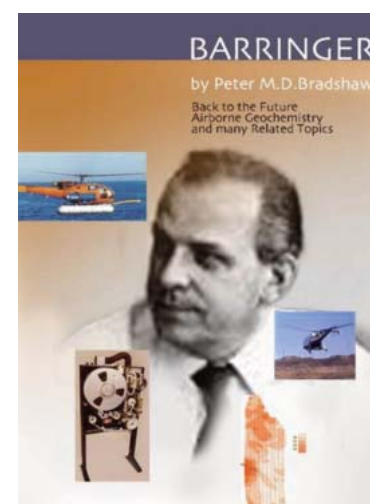
by Peter M.D. Bradshaw

The 1960s and 70s were marked by an explosion in mineral exploration and remote sensing technology. A leader throughout this period was Dr. Anthony (Tony) Barringer and his team at Barringer Research Ltd. (BRL). The highly successful airborne geophysical methods created at BRL are well known while the contributions to exploration geochemistry and many other fields are not. This book documents the many advances in geochemical theory, as well as the ground, airborne and remote sensing techniques plus analytical methods that were conceived and developed under the leadership of Tony Barringer. Innovative concepts backed by pioneering research funded by BRL on the movement of metals in rock, soil and vegetation remain important areas of investigation.

Tony Barringer's ability to bring together a diverse team including geologists, geochemists and physicists with electrical, optical and aeronautical engineers under one roof, provide leadership, a highly stimulating environment and financial support, was truly remarkable. This led to ground breaking advances in a number of different fields, including: exploration geochemistry for minerals and oil and gas; environmental monitoring from the ground, aircraft and space; and civilian and armed forces security. The underlying scientific principles for many of the inventions, now upgraded with modern electronics, are still considered state of the art. One of the many inventions from the BRL "incubator" described in this book is Ionscan, the drug and explosive screening device used in most airports today, which was conceived and developed by BRL in conjunction with technology for the detection of mineral deposits.

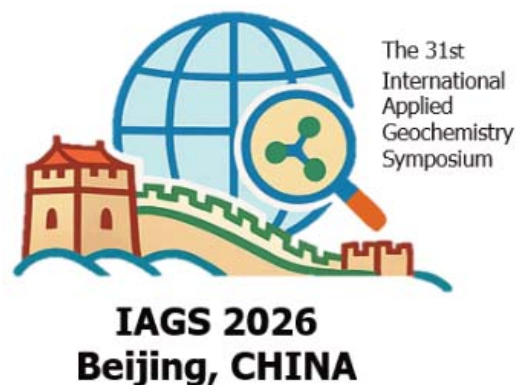
The book may be downloaded free of charge from the AAG website:

<https://www.appliedgeochemists.org/publications>



## 31<sup>st</sup> International Applied Geochemistry Symposium (IAGS 2026)

The Local Organizing Committee (LOC) and the Association of Applied Geochemists (AAG) look forward to welcoming you to the 31<sup>st</sup> International Applied Geochemistry Symposium (IAGS 2026), Beijing, China. This conference has the theme “Data-driven geochemical data mining in support of mineral exploration and environmental studies”. The symposium will showcase recent advances in data analytics, machine learning, and geochemical interpretation that are transforming the fields of mineral exploration and environmental geoscience. Join us in Beijing to share, learn, and collaborate on the latest scientific and technological developments in applied geochemistry.



### Aim of IAGS 2026

IAGS 2026 will highlight the transformative role of data science in applied geochemistry, emphasizing the use of advanced analytical and computational tools to unlock new insights from geochemical data. We aim to foster cross-disciplinary exchange and practical applications to address current challenges in exploration, environmental protection, and sustainable resource development.

### Why Beijing?

As the capital of China and a world-class city steeped in history and modern innovation, Beijing offers delegates a vibrant mix of ancient culture and scientific excellence. With landmarks such as the Great Wall, the Forbidden City, and the Summer Palace, the city also boasts leading universities and research institutions.

Beijing is home to China University of Geosciences Beijing (CUGB), a premier institution for geoscience research and education. The city provides easy international access, rich cultural experiences, and is a hub for geological and mineral exploration research in Asia.

### Local organizing committee (to be finalized)

| Name          | Position  | Affiliation                               |
|---------------|-----------|-------------------------------------------|
| Qiuming Cheng | Chair     | China University of Geosciences (Beijing) |
| Renguang Zuo  | Secretary | China University of Geosciences (Wuhan)   |

### Dates to remember

IAGS2026 will formally commence on September 12<sup>th</sup> and run through September 16<sup>th</sup> for the Scientific Program at the Geosciences International Conference Centre, CUGB. The 12<sup>th</sup> and 15<sup>th</sup> of September will not have scheduled Scientific Program events to make room for tours and workshops.

|                             |                                                                |
|-----------------------------|----------------------------------------------------------------|
| Saturday January 31, 2026   | <b>Topical Session Proposals Close</b>                         |
| Wednesday April 15, 2026    | <b>Abstracts Close</b>                                         |
| Friday May 15, 2026         | <b>Program Announced Including Workshops &amp; Field Trips</b> |
| Monday May 18, 2026         | <b>Early Bird Registrations Open</b>                           |
| Friday July 31, 2026        | <b>Early Bird Registrations Close/Full Price Opens</b>         |
| Saturday September 12, 2026 | <b>Symposium Begins</b>                                        |

### Proposed list of scientific sessions (TBC)

The final sub-themes of the scientific sessions of the conference, including the special sessions and the Chairpersons, will be announced in the second circular later in 2025 and also on the website (to be launched soon).

### Workshops

The IAGS 2026 LOC see conference workshops as a key part of the IAGS 2026 offering and experience. Workshops will likely be held pre-conference. Workshop pricing will be at standardized day-rates with discounts for students and members of some professional organizations.

The LOC is seeking expressions of interest from the geoscience community to run workshops at IAGS 2026. If you are interested in this, please contact Dr. Zhenjie Zhang (email: [iags2026@163.com](mailto:iags2026@163.com)) by December 1, 2025.

As part of your submission, please provide information regarding the following:

- Names of individuals who are leading/involved and the organization/s they represent,
- General topic and outline of workshop content,
- Brief outline of how the proposed workshop aligns with the targeted workshop themes listed below,
- Duration,
- Any requirements for the workshop venue (other than standard AV equipment),
- Representatives of commercial providers will need to demonstrate inclusion of general content non-specific to technologies or services they are promoting.

## IAGS 2026 Announcement... *continued from page 26*

### Suggested workshop topics

- Geochemical data collection, analysis, and interpretation applied to exploration, ore deposit characterization and/or remediation
- Geochemical characteristics of ore deposits, hydrothermal alteration and mineralization processes
- Isotope geochemistry and geochronology
- Environmental geochemistry and hydro-geochemistry
- Geology and geochemistry of the regolith/critical zone and transported cover
- Sample theory, sampling practices and QA/QC
- Training in commonly used geochemical and geological software
- Novel or commonly used geochemical and mineralogical technologies and their application, e.g., portable analyzers, micro-analytical techniques, scanning and imaging technologies
- Pre-competitive geochemical datasets and their application to exploration
- Geometallurgy, ore deposit knowledge, and characterization
- Soil geochemistry and viticulture
- Other topics relating to applied geochemistry where justified in the EOI submission

### Field trips

It is not mandatory to participate in IAGS 2026 to register for a Field Trip. Field Trips will be held with a minimum number of registered participants. A field trip will be planned for post conference.

### Sponsors

The LOC is seeking organizations interested in sponsoring the IAGS 2026, and invites potential Sponsors/Exhibitors to contact Dr. Zhenjie Zhang (email: [iags2026@163.com](mailto:iags2026@163.com)) for a prospectus. Participating as a Sponsor or Exhibitor provides your organization with the opportunity to demonstrate your level of support and commitment to the industry and connects your organization with your target audience.

### Conference fees

The IAGS and AAG will provide membership registration for IAMG members. Students and participants from some developing countries will be able to apply for a bursary to support travel to IAGS 2026. Please check the conference website regularly for application details.

| TICKET TYPE          | EARLY BIRD |            | STANDARD |            |
|----------------------|------------|------------|----------|------------|
|                      | Member     | Non-Member | Member   | Non-Member |
| All inclusive        | 650        | 800        | 700      | 900        |
| Sponsor / Exhibitor  | 450        | 450        | 450      | 450        |
| Symposium            | 550        | 750        | 600      | 800        |
| Student              | 250        | 250        | 300      | 300        |
| Gala Dinner          | 100        | 100        | 100      | 100        |
| N.B. Price is in USD |            |            |          |            |

#### All Inclusive registration:

Includes 3-day conference and gala dinner

#### Sponsor/Exhibitor registration:

3-day conference only

#### Symposium registration:

3-day conference only

#### Student registration:

3-day conference only

#### Gala Dinner registration:

Dinner only

### Visa information

If you are planning on attending IAGS 2026 from overseas, please consider the various options before going through the registration phase. China has some restrictive immigration laws, and we don't want you to get stuck if you are considering a visit to China to attend the conference.

The visa that you will have to apply for depends on your passport. We have provided the following link, but please make sure you read the information thoroughly before starting the process of your visa application.

<https://www.visaforchina.cn/> or <https://cs.mfa.gov.cn/wgrlh/lhqz/lhqzjjs/>

Good luck with this process, and make sure you are aware of the visa processing time, to make sure it's finalized before the conference.

### Latest Updates

If you would like regular information, and all the latest updates for IAGS 2026, please sign up for our mailing list by clicking the following link <https://forms.gle/px9KHJ7EKpG5xiBr8>





## CALENDAR OF EVENTS

International, national, and regional meetings of interest to colleagues working in exploration, environmental and other areas of applied geochemistry. These events also appear on the AAG web page at: [www.appliedgeochemists.org](http://www.appliedgeochemists.org).

### 2025

- 2–5 December WMS-SEG Senior Exploration Management Short Course. Littleton, Colorado, USA.  
<https://www.segweb.org/SEG/SEG/Events/>
- 7–12 December American Exploration Mining Association (AEMA) 2025 Annual Meeting. Sparks, Nevada, USA.  
[www.miningamerica.org/annualmeeting](http://www.miningamerica.org/annualmeeting)

### 2026

- 13–15 January Future Minerals Forum, 2026. Riyadh, Saudi Arabia. Website: <https://futuremineralsforum.com>.
- 24–25 January An introduction to exploration geochemistry, (Presenter - Dennis Arne, PhD). Association of Mining and Mineral Exploration BC (AMEBC) Cordilleran Roundup Convention Short Course. Vancouver, British Columbia, Canada. <https://roundup.amebc.ca/event/an-introduction-to-exploration-geochemistry/>
- 26–29 January Association of Mining and Mineral Exploration BC (AMEBC) Cordilleran Roundup Convention. Vancouver, British Columbia, Canada. <https://roundup.amebc.ca/>
- 9–12 February Mining Indaba 2026. Cape Town, South Africa. [www.miningindaba.com](http://www.miningindaba.com)
- 16–19 February Inaugural Mineralogical Society of America (MSA) Annual Meeting. Tucson, Arizona, USA.  
<https://msaweb.org/annualmeeting/>
- 23–24 February International Conference on Mineralogy, Petrology, and Geochemistry (ICMPG). Tokyo, Japan.  
[https://waset.org/mineralogy-petrology-and-geochemistry-conference-in-february-2026-in-tokyo?utm\\_source=conferenceindex&utm\\_medium=referral&utm\\_campaign=listing](https://waset.org/mineralogy-petrology-and-geochemistry-conference-in-february-2026-in-tokyo?utm_source=conferenceindex&utm_medium=referral&utm_campaign=listing)
- 1–4 March Prospectors and Developers Convention (PDAC 2026). Toronto, Ontario, Canada. [pdac.ca/convention-2026](http://pdac.ca/convention-2026)
- 26–27 March 16<sup>th</sup> International Association on the Genesis of Ore Deposits (IAGOD) Quadrennial Symposium. Porto, Portugal. <https://iagod2026.inporto.events/>
- 26–27 March Geological Society of Namibia, Uranium back to the Future. Swakopmund, Namibia.  
<https://geolsocnamibia.org/uranium-conference-2026/>
- 14–15 April Kamloops Exploration Group (KEG) Conference. Kamloops, British Columbia, Canada.  
<https://www.keg.bc.ca/conference/>
- 30 April–May 1 International Conference on Geochemistry and Isotope Geology (ICGIG). Vancouver, Canada.  
<https://www.iarfconference.com/conf/index.php?id=100211141>
- 24–29 May Gordon Research Conference, Geochemistry of Mineral Deposits. Avinguda de l'Hotel Castelldefels, Barcelona, Spain. [www.grc.org/geochemistry-of-mineral-deposits-conference/2026/](http://www.grc.org/geochemistry-of-mineral-deposits-conference/2026/)
- 26–28 May Geological Association of Canada (GAC®) Mineralogical Association of Canada (MAC) Annual Meeting. St. John's, Newfoundland and Labrador, Canada. <https://gac.ca/events/gac-mac-annual-meeting/>
- 12–17 July Goldschmidt 2026 Conference. Montréal, Québec, Canada.  
<https://conf.goldschmidt.info/goldschmidt/2026/goldschmidt/2026/meetingapp.cgi>
- 23–24 July 5<sup>th</sup> International Congress on Earth and Geological Sciences. Vienna, Austria.  
<https://unitedresearchforum.com/geology-earthscience/>
- 2–7 August Gordon Research Conference, Organic Geochemistry, Holderness School, Holderness, New Hampshire, USA. Website: <https://www.grc.org/organic-geochemistry-conference/2026/>
- 30 August – 2 September 16<sup>th</sup> Quadrennial IAGOD (International Association on the Genesis of Ore Deposits) symposium. Porto, Portugal. Website: <https://iagod.org/>
- 12–16 September 31<sup>st</sup> International Applied Geochemistry Symposium. Beijing, China. <https://iags2026.cugb.edu.cn>**
- 30 September – 3 October Society of Economic Geologists, SEG 2026. Salt Lake City, Utah, USA.  
<https://www.segweb.org/SEG-2026/SEG-Conference/SEG-2026/Home.aspx>
- 11–14 October Geological Society of America, Annual Meeting. Denver, Colorado, USA.  
[https://www.geosociety.org/GSA/GSA/Events/Annual\\_Meeting.aspx](https://www.geosociety.org/GSA/GSA/Events/Annual_Meeting.aspx)



## EXPLORE Publication Schedule

Quarterly newsletters are published in March, June, September, December

• **Deadlines** for submission of articles or advertisements:

March newsletter: January 15

June newsletter: April 15

September newsletter: July 15

December newsletter: October 15

- **Manuscripts** should be double-spaced and submitted in digital format using Microsoft WORD®. Articles should be between 2000 and 3000 words. Do **not** embed figures or tables in the text file.
- **Photos** (colour or black and white) should be submitted as separate high-resolution (minimum 300 dpi at the scale of reproduction) PNG, TIFF, JPEG or PDF files.
- **Figures** should be submitted as separate EPS, PDF or original software (e.g. CDR, AI) files.
- **Tables** should be submitted as separate digital files in Microsoft EXCEL® format (i.e. XLS).
- All scientific/technical articles will be reviewed. Contributions may be edited for clarity or brevity.
- Formats for headings, abbreviations, scientific notations, references and figures must follow the Guide to Authors for *Geochemistry: Exploration, Environment, Analysis* (GEEA) that are posted on the GEEA website at:  
<https://www.geolsoc.org.uk/geea-authorinfo>
- An **abstract** of about 250 words must also be submitted that summarizes the content of the article. This abstract will be published in the journal *Elements* in the Society News page in the back of each issue.

**Submissions** should be sent to the Editor of **EXPLORE**:

Beth McClenaghan

Email: [bethmcclenaghan@sympatico.ca](mailto:bethmcclenaghan@sympatico.ca)

## THE ASSOCIATION OF APPLIED GEOCHEMISTS

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[www.appliedgeochemists.org](http://www.appliedgeochemists.org)

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January – December 2025

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