

IAAGS

International Applied Geochemistry Symposium
30th edition

WORKSHOPS



INTRODUCTION TO OUR WORKSHOPS

Throughout the IAGS, and various days pre and post Symposium, we will be holding a variety of different Workshops.

Across our workshops, there will be a unique blend of educational and career-enhancing opportunities. These workshops will provide an in-depth learning experience, including hands-on activities and real-world applications. Attendance at a workshop will be your chance to stay abreast of the latest advancements and instrumentation, ensuring you remain competitive and well-informed within your field.

In addition to skill development, these workshops present an invaluable networking opportunity. The intimate setting of each workshop facilitates closer interactions and meaningful exchanges. Building connections with peers, mentors, and industry leaders can lead to collaborative research, career advancements, and long-lasting professional relationships.

The interactive learning environment of our workshops, with Q&A sessions, group discussions, and hands-on activities, will also ensure a dynamic and effective educational experience.

The combination of enhanced learning, networking, exposure to cutting-edge research, and practical applications makes these workshops an invaluable component of professional growth at the IAGS, and we look forward to welcoming you to our sessions.

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GEOLOGY AND GEOCHEMISTRY OF IRON OXIDE COPPER-GOLD DEPOSITS

LEAD: ADRIAN FABRIS, GSSA

Adrian Fabris joined the Geological Survey of South Australia in 2000 where he has since worked on projects related to regolith geoscience, economic geology and exploration geochemistry throughout South Australia and on commodities such as copper, heavy mineral sands, uranium, base metals and specialises in iron oxide copper-gold deposits.

PRESENTERS:

KATHY EHRIG, BHP

TOBIAS SCHLEGEL, CSIRO

JEFF STEADMAN, CODES

WHEN: THURSDAY OCT 10 - FRIDAY OCT 11 (2-DAYS)

VENUE: SA DRILL CORE REFERENCE LIBRARY, 5 TONSLEY BLVD, TONSLEY SA 5042

Iron oxide copper-gold (IOCG) deposits form some of the world's most significant mineral deposits. Since the discovery of Olympic Dam, IOCG deposits have been recognised elsewhere in the Gawler Craton and in a number of terranes world-wide. Understanding of IOCG systems have been developed over many years of research and discovery.

This workshop will provide a background understanding of IOCG systems, their characteristics, and discuss practical geochemical approaches to exploration for this style of mineral deposit. Drill core from world-class hematite-rich IOCG deposits will be on display along with examples of the diversity of alteration and mineralisation associated with these systems.

Specific focus will include

- Key deposit characteristics
- Alteration facies and their application to mapping the mineral system

Geochemical-based exploration approaches

Closed toe shoes, hand lens, hand magnet (optional)

AUSGEOCHEM: EXPLORING, SYNTHESISING AND PUBLISHING GEOCHEMICAL DATA THROUGH DYNAMIC COMMUNITY PLATFORM.

PRESENTERS:

DR FABIAN KOHLMANN, LITHODAT

DR WAYNE NOBLE, LITHODAT

DR ANGUS NIXON, UNIVERSITY OF ADELAIDE

PROF BRENT MCINNES, JOHN DE LAETER CENTRE, CURTIN UNIVERSITY

WHEN: SATURDAY OCT 12 (1-DAY)

AusGeochem is a geospatial platform combining a cloud-hosted relational database engine with full access and privacy control layer and a virtual laboratory capability for analysing and visualising complex geochemical datasets. The software allows researchers and laboratories to register georeferenced samples and upload, archive, disseminate and publish datasets, and provides minting services for internationally recognised identifiers such as IGSNs and DOIs. Users are able to keep datasets private prior to publication, while performing statistical analyses and data synthesis within the context of large volumes of publicly funded geochemical data aggregated from the user community. Geochemistry data management and standards are based on international best practice, drawing from international open data initiatives such as EarthChem and EPOS-ERIC and organised expert advisory groups. Presently the platform contains functionalities for inorganic geochemistry (major/minor/trace), U/Pb geochronology, fission-track thermochronology, and (U-Th)/He thermochronology, however the platform is constantly evolving and expanding to cover new techniques and applications. Our goal is to not just create a compilation of data from various methods, but to be a part of the community, creating a system that researchers will use as part of their normal research workflow.

Workshop Outline:

Part 1: Introductions

Goals of the AuScope Geochemistry Network and the AusGeochem Platform

Part 2: "Data Models - Under the Hood"

Technical Creation of the Platform

Part 3: AusGeochem Platform Tutorials

Platform Demonstration and hands on activities

Inputting, handling, and visualising data.

Part 4: AusGeochem into the Future

The future use of the platform - e.g. new data types, applications

APPLIED GEOCHEMISTRY OF PORPHYRY COPPER DEPOSITS

PRESENTERS: SCOTT HALLEY

Scott is a geologist and geochemist specialising in exploration geochemistry, particularly in the use of multi-element ICP geochemistry and SWIR analysis to map far-field expressions and alteration mineral zonation patterns around hydrothermal systems. In the last 20 years, he has consulted to more than 150 mining and exploration companies in more than 25 countries. Previously, he worked as an exploration geologist for 20 years, meaning that Scott understands how geochemistry can be practically and effectively applied to exploration and mining problems. As well as consulting, Scott is a regular presenter in the CODES MSc (Econ Geol) short course series, and a regular invited speaker at international geology conferences. Scott was the recipient of the Gibb Maitland Medal for 2012.

WHEN: SATURDAY OCT 12 (1-DAY)

This is a practical workshop interrogating a cross section of drill hole data from a porphyry copper system using ioGAS software. The components of the course include integrating assay data with logging information. This process provides a more robust classification of the rock types by combining the 2 data types.

Create a series of major element plots that allow classification of alteration facies and construction of a robust 3D mineralogy model. Merge major element geochemistry with SWIR data. This is a means of validating the SWIR information. Some components of the mineralogy are best defined from the SWIR data; some are best defined from the chemical analyses. A combination of both is required for a useful model. The best way to learn about geochemistry is a practical hands-on tutorial where you examine real data. Although this exercise is based on a porphyry Cu system, the same principles are applicable to any kind of mineral system.

Participants will require their own laptop computer. If you do not have a current ioGAS license, we will arrange a free trial version.

APPLIED DATA SCIENCE FOR GEOLOGISTS

LEAD: RIAN DUTCH, DATAROCK

Rian Dutch is the Head of Applied Science for Datarock, a technology services company who specialise in computer vision and machine learning solutions for mining and exploration. The company aims to transform geoscience data into actionable insights for mining and exploration companies, leveraging its world-class Applied Science team and innovative core imagery processing platform. Datarock also routinely provide training and workshops for industry and partners looking to learn more about the application and use of AI in mining and exploration.

PRESENTERS:

TOM CARMICHAEL - CHIEF DATA SCIENTIST, DATAROCK

JACK MAUGHAN - SENIOR DATA SCIENTIST, DATAROCK

MICHAEL WHITBREAD - LEAD GEOSCIENTIST GEOCHEMISTRY AND ANALYTICS, RIO TINTO

SAM SCHER - GEOCHEMISTRY AND APPLIED HYPERSPECTRAL CONSULTANT

ADDITIONAL INDUSTRY SPEAKERS TBC

WHEN: SATURDAY OCT 12 / SUNDAY OCT 13 (2-DAYS)

Machine Learning (ML) in geoscience has left the realm of curiosity; the mining and mineral exploration industries have adopted the advances that the field provides, from exploration through to ore body knowledge, mine planning and operations.

Join us to gain insight into core ML concepts in the context of geoscience. Gain an understanding of the possibilities and pitfalls of applied ML via a mix of theory, case-studies and first-hand accounts from industry and external guest-speakers.

This 2-day short course aims to introduce geoscientists to some of the powerful tools and techniques that exist within data science and machine learning. By the end of the course participants will have the confidence to identify aspects of you or your teams' geoscientific workflow that can be augmented by relevant ML technologies, while being more aware of common ML fallacies in the context of geoscience.

Cont.

APPLIED DATA SCIENCE FOR GEOLOGISTS Cont.

The course includes theory and practical applications of:

- Foundational theory of Machine Learning algorithms for clustering, dimensionality reduction and supervised classification
- An understanding of how these techniques can be applied to geoscientific problems within exploration and mining.
- Ask questions of any machine learning solution to help better understand it's utility and limitations.
- Ability to use Orange Data Mining/R/Python to:
 - Prepare, filter and manipulate data
 - Analyse/explore multivariate data using clustering and dimensionality reduction
 - Build simple supervised classification models

We won't presume any prior knowledge for the course, but it can be beneficial to have used Orange Data Mining (the software we do the practical in) prior to the course to familiarise yourself with the basics. There is ample time for questions during the class.

Each participant will need to have access to a computer, preferably with the latest version of Orange Data Mining installed, or administrator rights to install Orange Data Mining and any plugins during the course.

INTRODUCTION TO IOGAS & EXPLORATION GEOCHEMISTRY

PRESENTERS: PUTRA SADIKIN (IMDEX) & CARL BRAUHART (CAMP OVEN EXPLORATION)

Putra is a Melbourne based Geoscientist with 11+ years of experience in Geochemistry consulting, Exploration Geology and mining software product management. He is currently the Product Manager for ioGAS at IMDEX Ltd and the uncontested guru of all things ioGAS.

Carl is an Exploration Geologist with over 30 years experience in gold and base metal exploration. He is interested in Geochemistry, both Exploration Geochemistry and Ore Deposit Geochemistry, and has a passion for field work, particularly mapping. Carl maintains a close association with the Centre for Exploration Targeting at the University of Western Australia where he is the lead researcher on the OSNACA Project (an ore deposit geochemistry research effort).

WHEN: SATURDAY OCT 12 / SUNDAY OCT 13 (2-DAYS)

This two-day workshop provides an introduction to exploration geochemistry and the use of ioGAS software. The first day is an introduction to exploratory data analysis (EDA) on geochemical datasets. IMDEX ioGAS™ will be used as a tool to illustrate EDA concepts. This comprehensive course covers topics such as data validation/QC tools, univariate and multivariate plots, downhole and line plots to interrogate your drill-hole data, outlier detection and multivariate analysis methods.

The second day consists of Carl Brauhart's workshop, which begins with a PowerPoint presentation that outlines ten skills that prove to be extremely useful in Exploration Geochemistry time and again. The presentation is followed by six modules that use real world data to illustrate:

- The power of X-Y graphs to help establish multi-element relationships
- Probability plots as a data validation tool and a key to identifying separate populations
- Principal Component Analysis to further investigate these relationships
- K-means clustering and UMAP plots (Putra Sadikin)
- The concept of closure and its importance to correctly identifying mineralogical relationships
- Log additive indices to refine metal associations related to mineralisation
- Alteration geochemistry and the fundamental importance of tying geochemical relationships to mineralogy

Immobile element geochemistry to track variations in the original bulk composition of protoliths (a key to understanding alteration geochemistry) and also to identify different lineages of both igneous suites (melt source) and sedimentary sequences (provenance).

INTRODUCTION TO THE NATIONAL VIRTUAL CORE LIBRARY AND HYPERSENSPECTRAL MINERALOGY

PRESENTERS:

JESSICA STROMBERG, CSIRO MINERAL RESOURCES

CARSTEN LAUKAMP, CSIRO MINERAL RESOURCES

ALICIA CARUSO, GEOLOGICAL SURVEY OF SOUTH AUSTRALIA

WHEN: SUNDAY OCT 13 & WEDNESDAY OCT 16 (2-DAYS)

VENUE: (DAY 1) TBC

VENUE: (DAY 2) SA DRILL CORE REFERENCE LIBRARY

5 TONSLEY BLVD, TONSLEY SA 5042

The AuScope National Virtual Core Library is the world's largest publicly available drill core database and contains over 1.5 million meters of hyperspectral mineralogy data and a growing suite of supporting datasets including geochemistry and petrophysics.

This workshop will introduce the NVCL, the datasets available, the technologies used in their generation, including the HyLogger3 and MPL (Mobile Petrophysics Lab).

The workshop will also include a brief theory component covering an introduction to hyperspectral mineralogy, and best practice in drill core data collection and QA/QC. Case studies will be used demonstrate the applications of these datasets, advanced data analytics for multi-variate drill core data (MyLogger and Data Mosaic), and the added value of collecting both geochemistry and hyperspectral mineralogy. This will include a hands-on case study with an introduction The Spectral Geologist (TSG) software for investigating hyperspectral mineralogy and geochemistry together, extracting geochemical parameters from hyperspectral data, as well as core available for viewing.

MOLAR ELEMENT RATIO ANALYSIS: ITS USE IN LITHOGEOCHEMICAL EXPLORATION

PRESENTERS: CLIFF STANLEY, PHD

Cliff is a Professor of Applied Geochemistry and Economic Geology in the Dept. of Earth & Environmental Science, Acadia University, Wolfville, Nova Scotia, Canada. He has more than 30 years of research and teaching experience in Applied Geochemistry, and has been the most active contributor to the development of lithogeochemical data analysis techniques applied to mineral exploration over the last 20 years. Cliff is also active in consulting, providing several professional development courses (lithogeochemistry, geochemical data analysis, QAQC) and contract research services to the international mining community.

WHEN: SUNDAY OCT 13 (1-DAY)

Lithogeochemical exploration data have historically been evaluated by mining and mineral exploration geoscientists using relatively simple graphs and more complicated multivariate statistical procedures. New ways of investigating rock compositions utilizing molar element ratios (MER's) now allow geoscientists to directly relate the lithogeochemistry to the petrology of the rocks (or surficial materials) under investigation. These MER methods have now made substantial contributions to the disciplines of igneous, sedimentary and metamorphic petrology, hydrothermal alteration, weathering, and diagenesis, and have advanced procedures and knowledge in the mining-related fields of applied (exploration and environmental) geochemistry, mineral deposit genesis, metallurgy, and even hydrogeochemistry.

This short course will present the theory, principles, and procedures of MER analysis, as well as the practical considerations of sampling, sample preparation, and analysis appropriate for the technique. In addition, a number of case histories will be presented that illustrate how MER analysis can be used in a variety of applications to solve geochemical problems of interest to the mining industry. These will include examples involving mineral exploration for volcanic-, intrusion- and sediment-hosted mineral deposits formed by igneous, sedimentary and hydrothermal processes, how MER analysis can 'see through' metamorphism, and how it can be applied in 'greenfields' and 'brownfields' exploration programs.

Cont.

MOLAR ELEMENT RATIO ANALYSIS: ITS USE IN LITHOGEOCHEMICAL EXPLORATION Cont.

This short course will include several EXCEL exercises to illustrate the calculations made to produce MER diagrams of various types, and to guide the participants in how to interpret the results. Consequently, students should come to this short course equipped with a lap-top computer and Excel® spreadsheet program to construct some of the MER diagrams we will be examining in the practical exercises. Note that although 'MER Analysis' short courses have been presented in prior IAGS meetings (1995 in Townsville, 2001 in Santiago, 2007 in Oviedo, 2013 in Rotorua, 2018 in Vancouver), all consistently with large numbers of attendees. Updates and developments over the years have expanded the scope, scale, and application of MER analysis methods, so participants who have taken this course before will likely find it significantly revised and updated.

UNLOCKING EARTH'S SECRETS: GEOCHEMICAL TECHNOLOGY WORKSHOP

PRESENTERS: REPRESENTATIVES OF A NUMBER OF TECHNOLOGY PROVIDERS, INCLUDING OREXPLORE, VERACIO, CHRYSOS, EVIDENT, SCIAPS (SEE BELOW FOR FURTHER DETAILS) AND MORE!

WHEN: WEDNESDAY OCT 16 (1-DAY)

Harnessing new analytical technologies is key to advancing our understanding of our geochemical world, but only if you use them the right way!

This innovative workshop introduces a variety of cutting-edge geochemical and mineralogical analytical technologies, offering hands-on experience with equipment from several METS providers (listed below). The morning session includes introductory presentations by technology providers. In the afternoon, participants will have the opportunity to delve deeper into two selected technologies. Please choose the providers you wish to visit for the afternoon session under the descriptions below.

OREXPLORE: Cutting-edge 3D drill core sensing technology and sophisticated algorithms to unlock new insights from every inch of the core within hours. Orexplre will provide the opportunity to gain hands-on experience with Orexplore Insight®, the main 3D core analysing and investigating software. Interested parties will be provided with a demo data set to use; Existing customers are welcome to bring their questions and/or data.

CHRYSOS: Utilizing PhotonAssay™ for Enhanced Geological Insights. PhotonAssay delivers faster, safer, and more accurate gold analysis, PhotonAssay™ is an environmentally friendly replacement for fire assay on-site and in the laboratory. The presentation and workshop will cover an overview of the technology, geological and geometallurgical benefits and real-world applications proving PhotonAssay to be highly effective.

Cont.

UNLOCKING EARTH'S SECRETS: GEOCHEMICAL TECHNOLOGY WORKSHOP Cont.

VERACIO: Multi-sensor core and chip scanning to deliver rapid accurate orebody insights. Veracio scanning systems utilize multiple sensors such as XRF, RGB, LIDAR and soon to be hyperspectral to deliver rapid orebody insights. We will provide a detailed account of these systems along with an examination of various deployments and use cases.

EVIDENT: Practical application of handheld laser induced breakdown spectroscopy [LIBS] to geochemical analysis. Handheld LIBS allows rapid elemental analysis of a wide range of elements including many not possible using conventional methods such as pXRF such as Li, Be, B and C.

SCIAPS: The latest developments in portable XRF and XRD technology for in-field geochemistry and mineralogy.

In due course, we will be asking you which presenters you would like to visit.

GEOCHEMICAL LAB TOURS - NOBLE GAS, MEA, ATTA, XRD & XRF

LEAD: STACEY PRIESTLEY, CSIRO

PRESENTERS:

ALEC DESLANDES, CSIRO

RONG FAN, CSIRO

ROHAN GLOVER, ADELAIDE UNIVERSITY

WHEN: WEDNESDAY OCT 16 (1/2 DAY - 4 HOURS)

VENUE: CSIRO WAITE CAMPUS & ADELAIDE UNIVERSITY

Exposure to labs in Adelaide that are essential in the field of Applied Geochemistry. These lab tours align with all of the conference themes, but especially, Environment, Processing and Research.

The Mineralogical and Elemental Analyser (MEA) can be applied to monitor and analyse mineral phase and elemental properties in real-time at key points in the processing chain. CSIRO developed this new measurement system to enable real-time elemental and mineralogical analysis in a mineral beneficiation plant, called the Mineralogical and Elemental Analyser (MEA). MEA combines X-ray fluorescence (XRF) and X-ray diffraction (XRD) technologies to enable elemental and mineralogical analysis at the same time.

XRF and XRD Facility - This facility at CSIRO's Waite campus in Adelaide was designed to combine X-ray fluorescence (XRF) and X-ray diffraction (XRD) technology to enable real-time elemental and mineralogical analysis in a mineral beneficiation plant.

Cont.

GEOCHEMICAL LAB TOURS - NOBLE GAS, MEA, ATTA, XRD & XRF Cont.

Noble Gas Facility - This facility at CSIRO's Waite campus in Adelaide was designed for high sample throughput and high accuracy. It measures the stable noble gases and all their stable isotopes. Noble gas analysis allows us to understand the sources of water, where it comes from and what the recharge rates are, which then allows us to make decisions about sustainable extraction.

ATTA (Atom Trap Trace Analysis) - This facility at The University of Adelaide uses the latest laser technologies to drive the successful application of radioactive noble gas tracers for natural groundwater systems. It is an exceptional example of how quantum technology can be utilised to help overcome challenges facing our modern society. The lab measures the radioactive noble gases using laser cooling and trapping techniques. These isotopes have extremely low natural concentrations, less than one part per trillion in the environment, making measurement an incredible challenge.

A PRACTICAL GUIDE TO EXPLORATION HYDROGEOCHEMISTRY

PRESENTERS:

DR NATHAN REID, CSIRO MINERAL RESOURCES

ALEX HUNT, CSIRO MINERAL RESOURCES

CASSADY O'NEILL, CSIRO MINERAL RESOURCES

ROBERT THORNE, CSIRO MINERAL RESOURCES

WHEN: WEDNESDAY OCT 16 (1/2-DAY - 4 HOURS)

Hydrogeochemistry has become a tool of interest in regional mineral exploration in Australia for various commodities. CSIRO's Discovery Program has developed a practical workflow for mineral explorers which goes all the way from sample collection, field data capture (Fieldmark mobile app), sample analyses, data handling (QA/QC), and data interpretation and integration. CSIRO has also developed a number of indices and element ratios for mineral exploration using hydrogeochemical data which are able to highlight regions of known and potential mineralisation across Australia. We now have an online tool - XT Hydro™ - to make the processing of these indices easier than ever before. A process which was previously time consuming for researchers is now producing faster, and more consistent results. This has also led to the compilation of a continental scale hydrogeochemical database which provides baselines for many elements/parameters which can be used to put site data into perspective.

This workshop aims to introduce you to the why of hydrogeochemistry:

- what can it tell you about geology under cover, its strengths and weaknesses,
- targeting mineral systems at regional and camp scales,
- how to collect consistent samples and the tools we can provide
- what laboratory analyses are required and at what detection limits
- how to check your data (QA/QC)
- how to process data with XTHydro™
- How to interpret your data within the regional context and tips for targeting.

ISOTOPE GEOCHEMISTRY FOR EXPLORATION AND ENVIRONMENTAL APPLICATIONS

PRESENTERS:

ALEXANDRE VOINOT, GEOLOGICAL SURVEY OF CANADA - Lithium isotopes in conventional (LCT-pegmatites) and unconventional (Li-rich clays, brines) deposits

JAMES KIDDER, GEOLOGICAL SURVEY OF CANADA - Cu isotopes in porphyry deposits (Casino deposit, Yukon, CANADA)

Other invited speakers

WHEN: SATURDAY OCT 19 & SUN OCTOBER 20 (1 & 1/2 DAYS)

Since the beginning of the century, research using non-traditional stable (i.e., Li, B, Cu, Mo, Tl) and radiogenic (Sr, Pb, Nd) isotopes has been steadily expanding, thanks to significant advances in technologies, and a continuous effort from the scientific community to solve the numerous analytical challenges that come with this type of analysis. In this workshop, a panel of experts will present a current picture of state-of-the-art isotope analytical methods, including key innovations in method development and novel field applications. Case studies will be presented demonstrating real world examples of application in mineral exploration and environmental monitoring, including exploration in covered terrains, characterisation of key chemical reactions in mineral waste piles, or the tracking of environmental pollution through various media, to name a few. A discussion on the considerations that need to be considered to successfully use isotopes for mineral exploration and environmental monitoring will also be included, to provide the participants with all the information they need to include isotopes in their workflow and interpret the data generated.

REGOLITH GEOLOGY AND GEOCHEMISTRY

PRESENTERS: DR WALID SALAMA / DR DAVID COHEN / DR RYAN NOBLE

Dr Salama is a Principal research geoscientist at CSIRO Mineral Resources, with experience in regolith and mineral exploration in weathered and covered terrains.

Dr Cohen is Emeritus Professor at the University of New South Wales with around 35 years of experience in mineral exploration and geochemistry.

Dr Noble is a Senior Principal research scientist at CSIRO, specialising in soil chemistry and analytical techniques for mineral exploration.

WHEN: SATURDAY OCT 19 - SUNDAY OCT 20 (2-DAYS)

This two-day online course aims to introduce the fundamentals of regolith, landscape evolution, mapping, and techniques used in modern exploration geochemistry with a focus on Australian settings (semi-arid mainly). Each day will feature 4 x ~90 min sessions and time allocated for discussion. The format will be PowerPoint presentation with an aim for open communication, with input from participants highly encouraged to share knowledge and experiences. We may have a couple of working examples and exercises to solidify key concepts. Access to a laptop may be useful but not essential and materials will be provided as required. A copy of slides/notes and related materials will be provided on the day.

Day 1

1. Terminology and development of regolith profiles (Walid Salama)
2. Regolith-landscape processes and evolution, and the identification of key materials (Walid Salama)
3. Geochemical mapping (David Cohen)
4. Geochemical exploration approaches and sampling media in residual areas-case studies (Walid Salama)

Day 2

5. Geochemical exploration approaches, dispersion mechanisms, and sampling media in areas of transported cover-case studies (Walid Salama)
 - 5a. Cover in glacially influenced terrain settings and other weird cover types (uncommonly used/encountered in Australia at least)
6. Analytical methods/QAQC considerations (limitations, partial/total extractions, handheld devices) (Ryan Noble)
7. Testing ultrafine soils to improve near surface exploration through cover (Ryan Noble)
8. Putting results in landscape context (Next Gen analytics/LandScape+ as an example of how to do this) (Ryan Noble)



For further information please contact:

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