



CGI ANNUAL REPORT 2022 & 2023 BUDGET REQUEST

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1. Role of CGI

The Commission for the Management and Application of Geoscience Information (CGI) is a Commission of the International Union of Geological Sciences (IUGS).

- *Mission*

To foster the interoperability and exchange of geoscience information, by active community leadership, collaboration, education, and the development and promotion of geoscience information standards and best practice.

- *Vision*

- that geoscience information can be exchanged, understood, and used without limitation,
- that geoscience information can be readily integrated with standards-based information from other knowledge domains,
- that geoscience information is semantically rich and structured to enable seamless interaction in all environments,
- that global education about the management, modeling, exchange, and use of geoscience information enables its best possible application,
- that geoscience information is used for the benefit of all society.

2. Role within IUGS science policy

CGI fills the role of the geoscience information body of the IUGS. It represents IUGS on geoscience information matters, provides the means for transferring knowledge on geoscience information and systems, assists international dissemination of best practice in geosciences information, stimulates and supports initiatives which are developing standards, and its Council members hold significant positions within the international geosciences information community.

3. Organization, Council members and officers

- *Council Officers 2020-2024*

The CGI Council members are:

- Harvey Thorleifson (Chair) – USA
- Zhang Minghua (Co-Secretary General) – China
- Kombada Mhopjeni (Co-Secretary General) – Namibia
- Mark Rattenbury (Treasurer) – New Zealand
- Kazuhiro Miyazaki – Japan
- Éric Boisvert – Canada
- Christelle Loiselet – France

- Edward Lewis – UK
- Mauricio Pavan Silva – Brazil
- François Robida (former Chair) – France
- Ollie Raymond (Observer) – Australia
- David Percy (Observer) – USA

The Council was elected in 2020 for the term 2020-2024. One new member from the Brazil geological survey as the representative of South America was recommended and accepted in 2021. CGI Council members are now widely distributed across all the continents. The list of contacts is given in the Appendix.

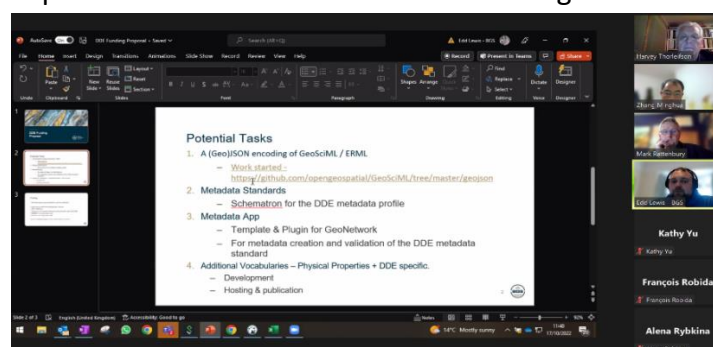
- *Important meetings in 2022*

Under the leadership of Chair Harvey Thorleifson, CGI remained very active in 2021 and 2022, utilizing the online means that have been dictated by the COVID-19 pandemic. Excellent CGI leadership meetings on 30th August, and 17th October, as well as council meetings on 26th January, 12th April, 30th June and 26th October were held on various relevant important issues such as CGI strategy, CGI standards implementation, geoscience knowledge graph and data science trends and cooperation between partners.

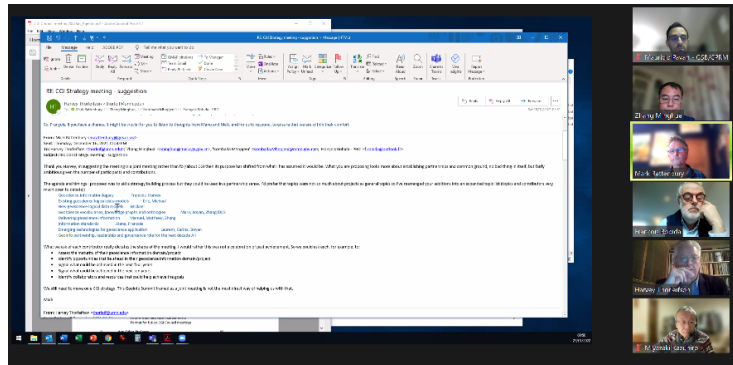
CGI also co-hosted IUGS big science program Deep-time Digital Earth (DDE) update meeting on 7th November and attended UNESCO-IUGS-DDE Open Science Forum on 9th November in Paris. CGI also successfully hosted Geoinfo Summits on 24th February, 19th May, and the two days follow-up on 20-21 September, 2022 which were attended by CGMW, CODATA, LOOP, OGC, DDE and OneGeology and several other relevant organizations.

Through these promotion and collaborative meetings in 2022, CGI has become more visible and authoritative in geoscience standards, for instance, International Commission on Stratigraphy (ICS) and several DDE WTGs invited CGI to be involved in their issuing of standards and data releases (*The Internetian Age: a new Stage in the ICS' information timeline by Nicholas Car on 7th Dec.2022; Meeting notes of DDE Geological Map Group 2022 and DDE Petroleum Geology Group 2022*).

Screen shots and pictures of some of these above meetings can be found bellow.



CGI leadership meeting on 17 October, 2022



CGI Council meeting on 26 January, 2022.



CGI Council meeting on 12 April, 2022.



CGI Council meeting on 30 June, 2022



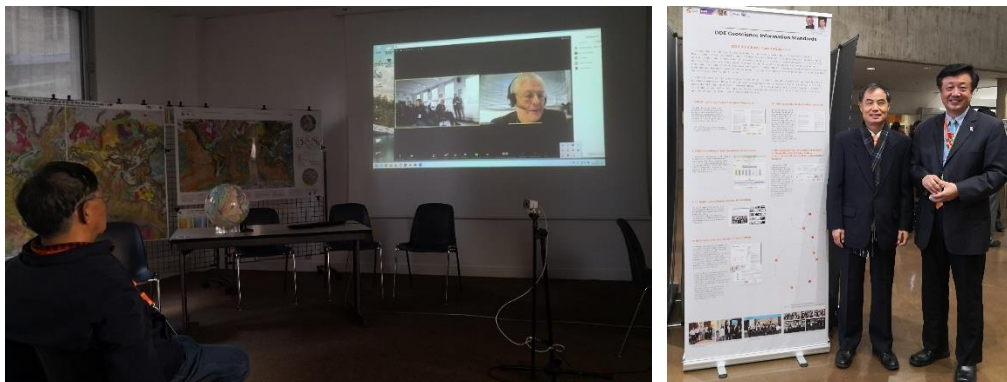
CGI Council meeting on 26 October, 2022



Geoinfo Summit on 24 Feb (left) and on 19th May (right) 2022



The Geoinfo Summit follow-up hosted by CGI on 20-21 Sept 14, 2022



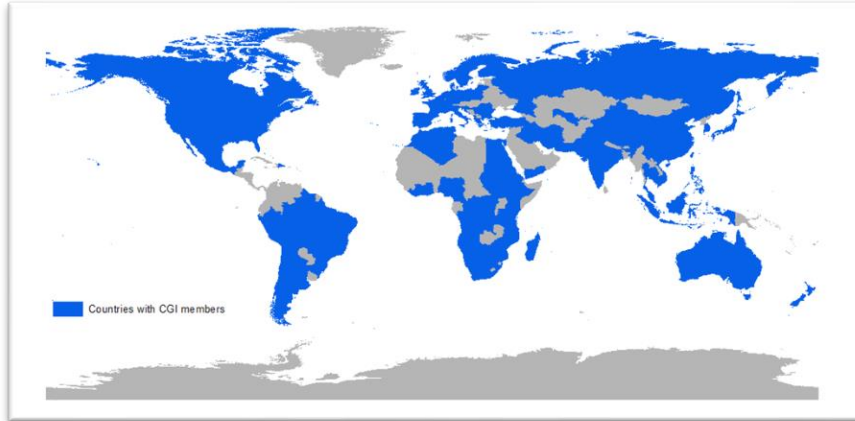
CGI and DDE-STG at DDE update meeting and DDE Open Science Forum in Paris on 7- 9 Nov,2022

The CGI secretariat is located at the Development Research Center of China Geological Survey, Ministry of Natural Resources. The contact email is CGIsecretariat@mail.cgs.gov.cn.

CGI working groups, regional networks, and current collaboration projects and working groups include:

- DDE geoscience standards task group, in collaboration with CODATA – Harvey Thorleifson (USA), Zhang Minghua (China) and Alena Rybkina (Russia)
- GeoSciML Standards Working Group (GeoSciML), in collaboration with the Open Geospatial Consortium (OGC) – Éric Boisvert (Canada)
- EarthResourceML Working Group (ERML) – Michael Sexton (Australia)
- Geoscience Terminology Working Group (GTWG) – Mark Rattenbury (New Zealand)

- Geoscience Domain Working Group, in collaboration with the Open Geospatial Consortium (OGC) – Mickael Beaufils (France)
- Geoscience Information in Africa – Network (GIRAF) – Mesfin Wubeshet Gebremichael, Tanzania



Global distribution of CGI members (countries in blue).

- *CGI Membership*

CGI now has 526 members in 82 countries across the world. Several new members from Ethiopia, Singapore and Canada have joined in 2022 during the pandemic which has affected activities of all geoscience organizations and CGI for three years.

CGI continued using the LinkedIn group (<http://www.linkedin.com/groups/6539642>) for some conferences and related documents, particularly working groups communications.

4. CGI online presence and Newsletters

- *CGI online updates 2022*

A key issue in the redirect from the previous web address <https://www.cgi-iugs.org/> to <https://cgi-iugs.org/> has now been fixed so users who have saved the old address will be redirected automatically.

There also has been significant rationalization on GitHub of repositories related to the functioning of geosciml.org, bringing them all under the <https://github.com/CGI-IUGS>.

Website: <https://cgi-iugs.org>

Twitter: https://twitter.com/CGI_IUGS

LinkedIn: <https://www.linkedin.com/groups/6539642/>

Working group / project links:

DDE: <https://cgi-iugs.org/project/ddestandards/>

ERML: [https://cgi-iugs.github.io /project/earthresourcemi/](https://cgi-iugs.github.io/project/earthresourcemi/)

GeoSciML: <https://cgi-iugs.github.io/project/geosciml/>

GTWG: <https://cgi-iugs.github.io/project/geoscienceterminology/>

OGC-CGI Geoscience Domain WG: <https://cgi-iugs.github.io/project/geosciencedwg/>



Key Projects

DDE Standards Task Group

A collaborative task group implementing geoscience information standards for IUGS's flagship Deep-time Digital Earth Project

Dr Zhang Minghua



EarthResourceML

A CGI working group developing and publishing data standards for mineral resources and mining information

Michael Sexton



GeoSciML

A collaborative OGC-CGI working group for the GeoSciML geological data standard

Eric Boisvert



Geoscience Terminology Working Group (GTWG)

A CGI working group developing and publishing multi-lingual geoscience vocabularies

Mark Rattenbury

The main page of CGI website

CGI updated its online flyers with updated coverage of its functionalities and collaboration partners in 2021. New releases on the website in 2022 include the excellent CGI Newsletters on 22 August, summarising important events in 2022, the past annual reports, and information on the new council member Mauricio Pavan Silva.

The collection of web statistics for the site can be found below in the following three figures. We've had a moderate increase in traffic over the previous year +8.1%.

Users are most commonly accessing the site from China and United States and using a Desktop device. Most users are then accessing the Geoscience Terminology, GeoSciML and ERML Pages. This may reflect that CGI standards and vocabulary are adopted or referenced by DDE scientists in China and US.



Photo: GeoInfo Summit participants, May 19th

In This Issue

- Feb 24th GeoInfo Summit – Harvey Thorelffson
 - CGI – François Robida
 - CGMW – Manuel Pubellier and Benjamin Sauter
 - Codota – Alena Iybkina
 - DDE – Junxuan Fan
 - Loop – Laurent Allières
 - OGC – Mickaël Beaudin
 - OneGeology – Matt Harrison
 - CGI renewal – Mark Rattenbury
- May 19th Discussion – Harvey Thorelffson

Feb 24th GeoInfo Summit – Harvey Thorelffson

CGI is the international Union of Geological Sciences (IUGS) Commission for the Management and Application of Geoscience Information. The goal of CGI is to foster the interoperability and exchange of geoscience information, through community leadership, collaboration, education, as well as development and promotion of standards and best practices.

On 24 February 2022, at 10 AM UTC, CGI and partner agencies hosted a 3-hour online GeoInfo Summit attended by geoscience information leaders from around the world. CGI Chair Harvey

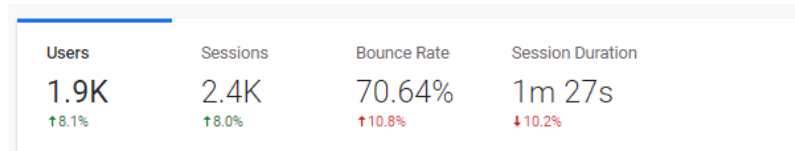
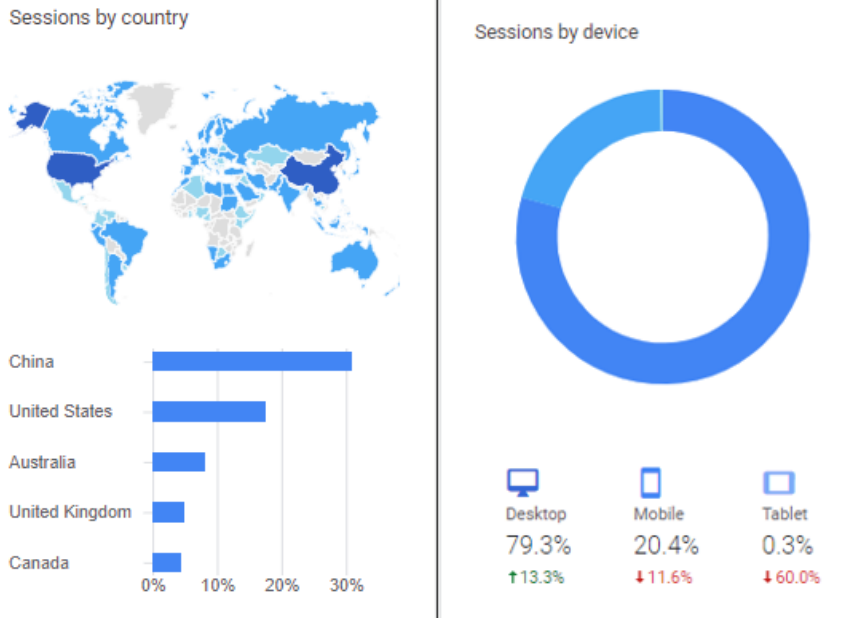


Figure 1 Summary Statistics



Session by country & device statistics.

Page	Pageviews	Unique Pageviews	Avg. Time on Page	Entrances	Bounce Rate	% Exit	Page Value
	3,942 % of Total: 100.00% (3,942)	3,232 % of Total: 100.00% (3,232)	00:02:12 Avg for View: 00:02:12 (0.00%)	2,378 % of Total: 100.00% (2,378)	70.64% Avg for View: 70.64% (0.00%)	60.32% Avg for View: 60.32% (0.00%)	\$0.00 % of Total: 0.00% (\$0.00)
1. /	1,928 (48.91%)	1,524 (47.15%)	00:01:44	1,423 (59.84%)	69.47%	62.81%	\$0.00 (0.00%)
2. /project/geoscience/terminology/	287 (7.28%)	224 (6.93%)	00:04:39	149 (6.27%)	51.32%	57.14%	\$0.00 (0.00%)
3. /project/geosciml/	274 (6.95%)	235 (7.27%)	00:03:59	107 (4.50%)	66.07%	62.04%	\$0.00 (0.00%)
4. /project/earthresource/ml/	180 (4.57%)	155 (4.80%)	00:02:59	75 (3.15%)	65.38%	57.78%	\$0.00 (0.00%)
5. /project/ddestandards/	132 (3.35%)	104 (3.22%)	00:01:43	39 (1.64%)	71.79%	37.12%	\$0.00 (0.00%)
6. /misc/links/	102 (2.59%)	77 (2.38%)	00:03:57	10 (0.42%)	70.00%	52.94%	\$0.00 (0.00%)
7. /1	63 (1.60%)	63 (1.95%)	00:00:00	63 (2.65%)	100.00%	100.00%	\$0.00 (0.00%)
8. /post/ddetraining/	45 (1.14%)	41 (1.27%)	00:02:03	12 (0.50%)	91.67%	44.44%	\$0.00 (0.00%)
9. /author/cgi-iugs/	44 (1.12%)	40 (1.24%)	00:00:52	34 (1.43%)	85.29%	75.00%	\$0.00 (0.00%)
10. /category/newsletter/	39 (0.99%)	39 (1.21%)	00:00:05	38 (1.60%)	100.00%	97.44%	\$0.00 (0.00%)

Top Ten Pages Statistics

(by Edward Lewis)

5. Extent of support from sources other than IUGS

Other than the substantial in-kind contribution by the geological organizations that pay the salaries and expenses of CGI Council and members, the CGI does not receive additional support. CGI workshops and activities are sometimes co-organized or

supported by other organizations and projects such as UNESCO, Minnesota Geological Survey, China Geological Survey, GNS Science (New Zealand), Geological Survey of Namibia, Geoscience Australia, the British Geological Survey, Bureau de Recherches Géologiques et Minières, Australian Aid, Geological Survey of Canada, United Nations Development program and the annual funding for the standards group of DDE.

6. Interaction with other international organizations

- *CGI collaboration with OGC*

CGI, in collaboration with OGC, is continuing to develop geoscience standards including the GeoSciML geology data model standard and borehole and geotechnical interoperation standards



by joint working groups of GeoSciML and Geoscience Domain Working Group. Both the OneGeology project and the past project OneGeology-Europe are using GeoSciML to make geological data interoperable and accessible via their web portals.

The European EC Directive INSPIRE used CGI products for their Geology and Mineral Resources Implementing Rules: The GeoSciML and Earth Resource ML (ERML) data model and CGI vocabularies. ERML was adopted by major EU funded projects as Mineral4EU or EURare.

- *CGI and CODATA*

CGI and CODATA jointly set up the DDE Standards Task Group in Oct 2019 and actively conducted relevant works plan continuously ever since, including a 3-year empowered R&D project on



Geoscience Information Standards for DDE which was approved in 2021 by DDE Science Committee. DDE-STG and CODATA had discussed on 9th November, 2022 on a further cooperation since 2023 for DDE geoscience disciplinary data to be FAIR (findable, accessible, interoperable, reusable) based on CGI standards and WorldFAIR framework.

- *CGI and DDE*

CGI is one of the founding members of the IUGS DDE program. CGI has been continuously active and successfully leading the DDE Standards Task Group (DDE-STG) in collaboration with CODATA and other DDE WTGs. A total of 30 geoscientists, including 15 CGI member geoscientists and CGI councilors, are now working in DDE-STG and its R&D project.



Apart from helping DDE on its geoscience knowledge system review, the DDE-STG and the project has delivered geoscience standards support to implement the DDE program.

- *CGI and OneGeology*

GeoSciML was adopted by OneGeology upon initiation of this international initiative in 2007. CGI's EarthResourceML data standard has also been implemented in OneGeology for mineral resource data. The OneGeology mineral service based on ERML lite was prepared in 2021 and it is ready for release.



7. Chief accomplishments and products

7.1 CGI News

- *CGI's leading role in the DDE Standards Task Group*

In 2022, DDE-STG updated DDE geoscience knowledge review procedure, circulated and revised DDE metadata standard, drafted DDE data evaluation guide and started compiling the DDE geoscience data standards framework plan and the DDE metadata App test online.

CGI and DDE-STG co-hosted meetings on 16th March, 2022 with DDE marginal seas group and on 27th July with seven DDE WTGs and DDE platform, the Geological Survey of Namibia and China University of Geosciences. CGI also presented and demonstrated the importance of standards at DDE update meeting in November 2022 in Paris.

- *CGI standards promotions*

CGI geoscience data standards and vocabularies were introduced to scientists, geologists and officials from a variety of organizations and initiatives at events and workshops in 2022, including CGI hosted and co-hosted workshops, DDE meetings, as well as regional sessions in South America, Asia and others.

At the CGI lead Geoinfo Summit meetings and follow-up discussions in 2022, participants from relevant organizations agreed to focus on digital twins as one of the next generations of geoscience information technology that integrated multiple disciplinary data and a variety of methodologies of data acquisition for a dynamic geoscience mapping, visualization and prediction, and CGI was planned responsible for standards for the whole.

At the DDE update meeting on 7th November in Paris, CGI former chair Francois Robida was invited to present a talk on the importance of geoscience standards for international initiatives and programs. At the UNESCO-IUGS-DDE Open Science Forum on 9th November in Paris, CGI secretary general and co-leader of DDE-STG Zhang Minghua was involved in discussions on CGI and relevant geoscience standards that help DDE data achieving FAIR Principles compliance.



CGI officials at DDE update meeting on 7 November (left) and UNESCO-IUGS-DDE Open Science Forum on 9 November (right) in Paris

At the international training course on Resource and Environmental Science Data Sharing and Knowledge Services for Disaster Prevention and Mitigation on 20-24 November 2022 online, as the Mission of the UNESCO International Centre for Knowledge in Engineering Science and Technology (IKCEST), CGI co-secretary general Zhang Minghua delivered a report of CGI-IUGS and DDE standards group. The training course attracted around 200 students from 40 countries including Pakistan, Russia, Mongolia, Nigeria, Bangladesh, Nepal, Ghana, Sudan, Egypt, Indonesia, Ethiopia, Iran, Kenya, Peru, Yemen, Albania, Algeria, Myanmar, South Africa. Some students with geoscience background requested to join CGI during Q/A and the discussion.

7.2 Working Group Reports

7.2.1 GeoSciML Standards Working Group



The official OGC GeoSciML Standards Working Group (SWG) is jointly administered by the CGI. The SWG has been largely inactive in 2022 due to the maturity of the GeoSciML standard, ongoing pandemic-related travel disruptions and the unavailability of the SWG chair. 2023 will mark the 20th anniversary of the SWG

- *Membership and repository*

The GeoSciML SWG membership stands at 45 members and observers. The public GeoSciML mailing list has 97 registered members from Australia, Austria, Belgium, Brazil, Canada, China, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Poland, Portugal, Russia, Spain, Sweden, UK, and USA.

GeoSciML schemas on the OGC public schema site are at GeoSciML: <https://cgi-iugs.github.io/project/geosciml/> and <http://schemas.opengis.net/gsm/4.1/>. The GeoSciML SWG's GitHub repository provided by OGC is located at <https://github.com/opengeospatial/GeoSciML>. Sylvain Grellet (BRGM) and Éric Boisvert (GSC) have management responsibilities.

- *Meetings and activities*

There were no official GeoSciML SWG meetings during 2022. A CGI Council grant to GeoSolutions for docker containerization of the ERML data standard (an extension of GeoSciML standard), managed by Mark Rattenbury and Eric Boisvert, was completed in October. The goal of the project is to simplify the deployment of ERML or any other standard supported by Geoserver, where the data provider has limited resources to deploy a simple static database. The contracted work involved the development and documentation of a process for publishing complex geology data features via docker image containerization and configure this in GeoServer.

- *Uptake*

Beyond implementation of web services, GeoSciML keeps attracting attention from various standardization initiatives that seeks to extend it to associated domains, such as GEOL_BIM (<https://www.espazium.ch/fr/actualites/mieux-protger-les-batiments-contre-les-glissements-de-terrain-avec-le-bim>) and Geotechnic (<https://aecmag.com/opinion/ifc-for-infrastructure/>). GeoSciML and the extensive work made on GeoSciML vocabularies remains the starting point from the knowledge representation community, demonstrating its lasting influence. GeoSciML also started being mentioned in online courses (<https://www.coursehero.com/study-guides/wmopen-geology/outcome-scientific-tools/>).

- *Future work*

The popular GeoSciML-Lite model standard previously identified as a quick win for *JSON encoding is expected to progress with the awarding of a CGI-DDE contract to the British Geological Survey to develop a GeoJSON encoded version of the GeoSciML-Lite standard early in 2023.

(by Mark Rattenbury and Eric Boisvert)

7.2.2 Geoscience Terminology Working Group

- *Activities*

The membership of the group numbers 29. Members come from Australia, Brazil, China, Denmark, Finland, France, Germany, Great Britain, Italy, New Zealand, Poland, Russia, Slovenia, Spain, Sweden and USA. Membership is defined and managed through a Google Group with membership rights administered by Mark Rattenbury (NZ, Chair since 2014) and Steve Richard (USA). Actual participation in vocabulary development and management involves only about half of the membership.

A 2022 face-to-face meeting was not held due to ongoing travel restrictions imposed on many in the community because of the Covid-19 pandemic.

The GTWG activities are described under link from CGI's website, simplified and updated in late 2016, http://www.cgi-ugs.org/tech_collaboration/geoscience_terminology_working_group.html and from the GeoSciML website at <http://www.geosciml.org/>.

- *Achievements*

No new vocabularies have been adopted. Progress has been slowed in part because of not having a face-to-face meeting to accelerate vocabulary publication and because the vocabulary publication process is still being worked through. The CGI Council grant to the British Geological Survey for vocabulary services has been completed and has resulted in a functioning VocPrez service on Github architecture. BGS also updated SKOS-RDF files by adding translated multi-lingual terms and links for many existing vocabularies, including links to all related INSPIRE vocabularies. A merge request has been created for their publication and actioned. The vocabulary publication process has been tested on successful updates to three vocabularies; BoreholeDrillingMethod has subcategories of rotary drilling and coiled tubing drilling added, CommodityCode has several new rare earth element oxides, chemical oxides, potash and mineral sand types, and ProcessingActivity has added three subcategories of leaching.

The vocabulary host service, managed by Geoscience Australia, is working well for published vocabularies and these are findable in the Australian National Data Service (ANDS) Research Vocabularies Australia (RVA) [Portal](#).

The CGI vocabularies are widely recognized for their authority and strong governance, featuring in presentations in the Vocabulary Symposium (Canberra, November 2022), including Nick Car's on the Australian geo-vocabulary governance regime. Mark Rattenbury was invited and presented online to the Soil Information ESIP cluster in August on geoscience terminology and CGI vocabularies.

- *Future Work and Issues*

There remain a number of outstanding GeoSciML data model vocabularies still to complete, although as a priority the GeoSciML Basic module and EarthResourceML requirements have been prioritized. The Deep-time Digital Earth (DDE) Big Science Program includes a large component of semantic ontology development and this overlaps with GTWG vocabularies to some extent. The DDE Standards Group, co-led by CGI, is coordinating some of this, potentially through a CGI Council grant in 2023. The process of converting a standardized spreadsheet template vocabulary (new or for updating) into SKOS-RDF (TTL) files for publishing using VocPrez needs to be facilitated with scripting with lower technical knowledge requirements and process documentation. This coupled with improved governance and prescribed authority rules imposed through Github may also be proposed for CGI Council grant funding.

Working group activity is still unsatisfactorily low and another year without a face-to-face meeting due to Covid-19-imposed restrictions has exacerbated that.

(by Mark Rattenbury)

7.2.3 EarthResourceML (ERML) Standards Working Group

- *Activities*

This ERML SWG-report covers the period from January 2022 to December 2022.



The ERML WG has 25 members, from Australia, Brazil, China, Canada, Denmark, Finland, Sweden, France, Great Britain, New Zealand, Poland and USA. Membership is defined and managed through a Google Group with membership rights administered by Michael Sexton (AUS, chair since 2021).

Two online meetings were held for the ERML WG, the first in May and the second in November. The 2022 face-to-face meeting was intended to be held in November, but due to difficulties in securing a venue, an online meeting was held in its place. Arrangements have been made to have a face-to-face meeting that coincides with the GIC in May 2023.

The ERML WG activities are described under links from the CGI website http://www.cgi-iugs.org/tech_collaboration/earthResourceML.html. Vocabulary work for ERML and GeoSciML standards can be seen via GTWG website at http://www.cgi-iugs.org/tech_collaboration/geoscience_terminology_working_group.html.

- *The ERML data model*

Version 2.0 of the CGI data standard for mineral occurrences and mines was published in 2014: <http://www.earthresourceml.org/>. After small modifications in 2015 and 2016, ERML is now fully compatible with the requirements of the European Commission's INSPIRE data specification for Mineral Resources.

ERML Lite 2.0.1 was published 2018, and it is implemented in Australia (AusGIN) and on the OneGeology Portal.

Further work with GTWG was conducted in 2022, with new terms added to the CommodityCode and ProcessingType vocabularies. Work on ERML3 continued, with further suggestions made to improve the data model.

- *Documentation*

All the CGI SWG web pages have been harmonized, and the ERML web pages (http://www.cgi-iugs.org/tech_collaboration/earthResourceML.html) have been updated. The data model documentation has been published in the ERML web pages.

- *Uptake of EarthResourceML*

The uptake of ERML continues, albeit at a reduced pace compared to previous years. However the ERML data standard continues to be used for national and subnational geological surveys, for example in Australia and Europe, mainly through its adoption by data sharing communities such as OneGeology, AusGIN, INSPIRE/Minerals4EU and

EGDI. In the medium term, the major challenge is to get USGS/USA and GSC/Canada to join as active participants to develop/implement the ERML standard. Recently, Chinese organizations and the British Columbia Geological Survey in Canada have been actively supporting the SWG.

(by Michael Sexton)

7.2.4 The Joint CGI/OGC Geoscience Domain Working Group

- **Activities**

On February 22nd, the Joint CGI/OGC Geoscience Domain Working Group (GeoScienceDWG) had the kick-off of its second Interoperability Experiment. The Geotech IE is studying and highlighting the complementarity of standards from buildingSmartInternational (aka. bSI, <https://www.buildingsmart.org/>), AGS (<https://www.ags.org.uk/>), DIGGS (<https://www.geoinstitute.org/special-projects/diggs>) communities with the OGC-CGI standards. It aims at setting a common conceptual model between those standards, but also propose to demonstrate the fitness of OGC APIs for the provision of geotechnical data. Many concepts from OGC / CGI-IUGS models like GeoSciML, GroundWaterML2, but also EPOS and INSPIRE are reused. See: <https://github.com/opengeospatial/Geotech/wiki>

The GeoScienceDWG also met during the OGC June TC that was held in Madrid. This was a small 45 minutes session with a focus on the topics of geotechnics. The agenda included a report of Geotech IE (M.Beaufils - BRGM) and a presentation of DIGGS (Dan Ponti - DIGGS Steering Committee). One highlight was that the DIGGS standard rely on OGC components (eg. GML) and have a lot in common with standards like Observations & Measurements, GeoSciML in their approach.

- **Achievements**

A new version of the standard Observations & Measurements is submitted to ISO as ISO19156 v2. The new OMS (for Observations, Measurements and Samples) mainly revisit the semantics of O&M and also provide a solution for the provision of the sampling activity, mimicking what is done for observation (following a SamplingProcedure, resulting in a Sample, made by a Sampler). Geotech IE conceptual model is mostly based on OMS.

In terms of implementation, the standard OGC SensorThingsAPI (STA) is studied as a suitable way to expose borehole data. Members of the STA SWG are currently working on the provision of geotech tests results including CPT, SPT, Pressuremeter. Results from the BoreholeIE are taken into consideration. This work will certainly propose an update of the BhML model from BoreholeIE based on novelties regarding linear referencing.

Semantics is also a topic of choices, several GeologicalSurveys are going further with the definition and sharing of vocabularies. Codelists from CGI and INSPIRE are usual

bases of extensions for national or local purposes.

- *Future Work and Issues*

Geotech IE is strengthening the links with the communities of bSI, AGS and DIGGS. Also the topic of geotechnics is quite a driving force for geological surveys. SwissTopo presented a study of the reuse of OGC standards for geotechnics. Proposal of reuse and/or extension of GeoSciML, GroundWaterML2 were made.

bSI envisages to set a dedicated room (similar to a Domain Working Group) for the topic of geotechnics. Official collaboration with OGC is wished. The GeoScienceDWG is identified as the group to be in connection with this future room. This would be specified through a Memorandum of Understanding.

DIGGS is very close and compatible with OGC standards. It could be envisaged to be even closer with DIGGS becoming a SWG in OGC.

With recent projects all around the world regarding Earth Resources, there is an international interest on the topic of Mineral Resources. While making enhancements on regard of EarthResourceML, it should be envisaged to have it endorsed by OGC (as it was done for GeoSciML).

(by Mickaël Beaufile)

7.3 CGI Region Reports

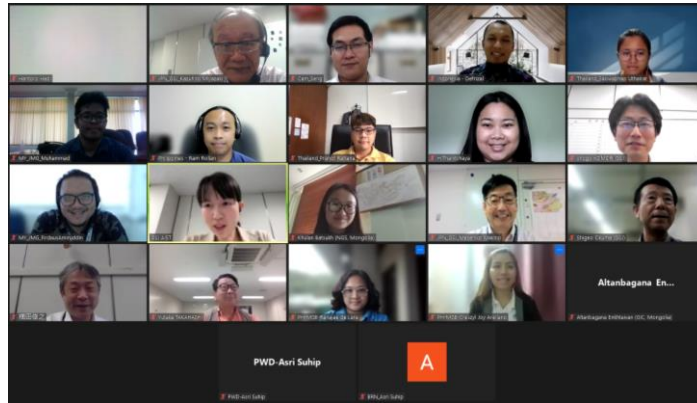
7.3.1 CGI in Asia

Meetings, activities and projects were continuously affected by the COVID-19 pandemic in 2022. However, several important activities in geoscience information technology promotion and CGI-IUGS standards implementation have been conducted and achievements were made.

The Geological Survey of Japan (GSJ) supported the Coordinating Committee for Geoscience Programs in East and Southeast Asia (CCOP) countries in the formulation and server hosting of the WMSs of their geological maps for OneGeology portal registration. These WMSs include the geological maps of Indonesia, Malaysia, Vietnam, Mongolia, Myanmar, Philippines, and Papua New Guinea. The WMSs of Laos, Thailand and South Korea are hosted by these countries' servers. Furthermore, Japan registered 120 maps to the OneGeology portal. These maps include the 1:10M Geological Map of Asia, 1:200K Geological Maps of Japan, 1:200K Seamless Geological Map of Japan, 1:10M Earthquake Source Region, 1:10M Tephra Fall Distributions, 1:2M Volcanoes of Japan, 1:2K to 1:50K Geological Maps in volcanic areas in Japan.

A Webinar 2022 on Practical Geological Survey Techniques was held by GSJ focused on application to geological disaster mitigation from July 5 to July 21, 2022. The webinar was delivered via online lectures and practical training sessions due to the COVID-19

pandemic. Lectures include geological disaster mitigation, practical training on GIS and cloud-based GIS, and practical training on remote sensing. Twenty-seven trainees officially nominated from seven of the CCOP member countries—Brunei, Cambodia, Indonesia, Malaysia, Mongolia, the Philippines, and Thailand—participated in the webinar. And next course in early 2023 will be delivered based on feedbacks from the trainees and lecturers.



Webinar on Practical Geological Survey Techniques 5-21 July, 2022



The 6th International Workshop of CCOP GSi Project 24-25 Feb, 2022

GSI has also been implementing the CCOP Geoinformation Sharing Infrastructure (GSI) for East and Southeast Asia project in cooperation with the geological institutes in East Asia since 2016. More than 1,000 geological maps and related information are presently available on the GSi system. There are also more than 20 portal sites from CCOP countries that were setup using the GSi system. The 6th International Workshop (Zoom Online) of the CCOP GSi project was held on February 24-25, 2022. Representatives from Brunei Darussalam, Cambodia, Indonesia, Japan, Korea, Lao PDR, Malaysia, Mongolia, Myanmar, Papua New Guinea, Philippines, Thailand, and Vietnam attended the activity.

GSI also developed the ASEAN Mineral Database and Information System (AMDIS) and conducted the International Workshop on ASEAN Mineral Database and Information System (Zoom Virtual Workshop) from 14-15 Feb, 2022.



Workshop of ASEAN Mineral Database and Information System 14-15 Feb,2022

China Geological Survey (CGS) hosted a series of workshops on geoinformation and big data technology for ASEAN states on 22-25 Nov, 2022. The workshop was held in hybrid with some 50 participants in person and 800 attendees on line. Presentations, talks and remarks from China, Philippines, Laos, Cambodia and Thailand include advanced Big Earth data used to monitor and evaluate 25 targets under 7 SDGs of UN 2030 with demonstrations of zero hunger, clean water, affordable clean energy, sustainable cities and communities, climate action, life below water and life on land, conjunction belts study in north Thailand, tectonics and evolution of Indochina peninsula, the evolution of Tethys and mineral resources, progress in digital Sichuan basin construction, recent studies of regional hydrogeology and karst in east and southeast Asia, geochemical mapping theory and application in Asia, China-ASEAN geoinformation and big data platform 1.0, machine learning and AI technology applications in Earth science, thematic remote sensing image data processing, CGI-IUGS standards, and IUGS DDE program goals and progresses, etc.



The hybrid workshops on geoinformation and big data technology for ASEAN on 22-23 Nov,2022.

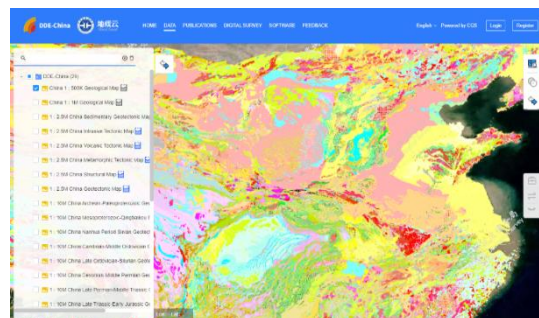
CGS hosted CCOP-IGDP workshop online on 22-23 Nov, 2022. The workshop on geoscience information of the CCOP-IGDP project was held online on 22 -23 November 2022. 36 participants from CCOP member countries attended the workshop from Brunei, Cambodia, China, Japan, Malaysia, Myanmar, Philippines, Thailand, Vietnam. Talks include AI for minerals and fossil recognition, cloud-base integrated geoscience data processing techniques, knowledge based geological map compilation automation

and software, digital national geological archives and catalogue, CCOP regional geophysical compilation techniques, etc. next workshop was also planned in next spring, hopefully in person.



Online CCOP-CGS IGDP workshop on 22-23 Nov, 2022

CGS attend UNESCO-IUGS-DDE Open Science Forum in Paris on 9th Nov,2022. As the China node of DDE program, CGS released 1:500,000 geological map data of China and some other 30 thematic maps data thru standard data services including tectonics and geochemistry in 2022 and made presentation in UNESCO headquarters at the DDE open science forum in Paris.



<https://geocloud.cgs.gov.cn/DDE-China>

CGS attended UNESCO-IUGS DDE open science forum on 9 Nov 2022 in Paris

(by Kazuhiro Miyazaki and Zhang Minghua)

7.3.2 CGI in Africa

There were still few activities in Africa in 2022 due to COVID-19 pandemic. The GIRAF workshop was postponed several times and has lost some momentum.

The Geological Survey of Namibia is hosting the Colloquium of African Geology (CAG), a major biennial meeting organized under the auspices of the Geological Society of Africa (GSAf), in Windhoek, Namibia from 26-29 September 2023.

(By Kombada Mhopjeni)

7.3.3 CGI in South/Latin America

For the year 2022, the efforts from geoscientists teams in the geological surveys of South America, focused on projects within their own organizations.

We can highlight some workshop events from the Association of Iberoamerican Geological and Mining Surveys (ASGMI), with the presence of countries from America and Europe. In these events the discussion about the interoperability of geological data between the countries and the standardization of the information is always addressed. In September occurred in Colombia the workshop "Geochemical Information for Society"; in November, during the "10th Brazilian Symposium on Mineral Exploration", there was a closing meeting about the Metallogenic Map of South America, which involves the development of the map and also an integrated database. In June there was an online workshop between the Geological Survey of Brazil (SGB-CPRM) and the Geological Survey of Colombia (SGC), about geophysical data and machine learning.

At the conference Argentina's Hydrocarbons Exploration & Development Congress, Geotechnologies Conferences on 9th November 2022, CGI scientist Gabriel Asato gave a speech on international geoscience standards and projects with great success, which caught the interest of Argentine oil companies, especially as international oil and gas companies are beginning to develop a new initiative related to information systems called the open source group OSDU (<https://osduforum.org/about-us/who-we-are/osdu-mission-vision/>). Further communications for a bridge between CGI or DDE and OSDU were made.



CGS scientist attended Argentina's Hydrocarbons Exploration & Development Congress, Geotechnologies Conferences on 9 Nov.2022

(by Mauricio Pavan Silva)

7.3.4 CGI in North America

In the US, new Federal Geographic Data Committee (FGDC) reporting is now governed by the Geospatial Data Act 2018. In the US, the 3D Nation Elevation Requirements and

Benefits Study has launched yet another era of accelerated lidar acquisition. EarthCube and Earth Science Information Partners have been active. National datasets are a focus, to support applications such as earthquake propagation modeling, water resource management, energy and minerals assessment, and infrastructure planning. The White House signed a budget bill that yet again increased funding to the geological mapping program, which has been doubled since 2019, with a focus on seamless, evergreen national compilations, and funding to drillhole data and related info has increased over 8-fold. A late 2021 bipartisan infrastructure bill in Washington DC provided US\$320M over five years, for aeromagnetic surveys and associated critical minerals assessments. Progress in Canada continues on Canada3D, and the related Canada 1 Water initiative, as well as national geoscience planning for example related to minerals. In-person meetings such as Digital Mapping Techniques and the Geological Mapping Forum, that shifted to virtual during the pandemic, are experimenting with remaining online, going hybrid, or attempting in-person only. A highly successful 3D geological mapping workshop was held in Denver in October 2022.

(by Harvey Thorleifson and Éric Boisvert)

7.3.5 CGI in Europe

Like last year, there has been much activity on the EGDI and development of EPOS infrastructure, a platform for EU researchers.

- ***EuroGeosurvey - GSEU Geological Services for Europe***

A group of 50 European partners from national and regional geological survey organisations (GSOs) has joined forces to develop an CSA Horizon Europe project.

GSEU project will continue the harmonisation and standardisation effort initiated in earlier projects such as GeoERA.

The main objective is to contribute to the optimal use and management of the subsurface. The projects will cover the applied geosciences, addressing the following four themes: geo-energy, groundwater, raw materials, 3D geological modelling, coastal vulnerability assessment and information platform. The information platform will support the requirements of the three other themes, and in particular for data dissemination. It is built on the top of the EGDI (European Geological Data Infrastructure). EGDI is EuroGeoSurveys' European Geological Data Infrastructure. It provides access to Pan-European and national geological datasets and services from the Geological Survey Organisations of Europe using CGI standards (GeoSciML and EarthResourceML). Data delivery will use CGI Standards.

- ***EPOS and GeoInquire Horizon Europe Project***

EPOS(<https://www.epos-ip.org>), the European Plate Observing System, is a long-term

plan to facilitate integrated use of data, data products, and facilities from distributed research infrastructures for solid Earth science in Europe.

In link, the Geo-INQUIRE (Geosphere INfrastructures for QUestions into Integrated Research) project begins in 2022. Geo-INQUIRE is a Horizon Europe-INFRA project funded by the European Commission. Geo-INQUIRE is made up of 51 partners from 13 countries across Europe and It is led by GFZ Potsdam. The kick-off meeting took place in early last October in Potsdam, Germany.

The activities and objectives of the project are strongly linked to several Research Infrastructure such as EPOS, EMSO, ECCSEL and contribute to a reinforcement at European level between the different Research Infrastructures.

In this project, geological data will be served through “Thematic Core Services” based on CGI standards, delivering for instance access to millions of boreholes across Europe. EPOS also contributed to the CGI/OGC Borehole Interoperability Experiment.

(by Loiselet Christelle)

7.3.6 CGI in Oceania

The Australia/New Zealand Government Geoscience Information Committee (GGIC) met three times in 2022, including one face-to-face meeting in Adelaide. The following projects have been completed or have made substantial progress:

- *Geoscience vocabularies*

Vocabulary development has been a strong activity in Oceania with state geological surveys in South Australia and Western Australia installing their own services and making improvements to existing vocabulary services hosted by Geoscience Australia and the Geological of Survey of Queensland. The vocabularies being pushed up are to complement existing vocabularies such as CGI’s rather than replace them. The vocabulary production process is following developments by Surround Australia and more latterly KurrawongAI utilising the GitHub web-based coding repository. The process involved vocabulary construction within a structured Excel template that can be converted into a SKOS-RTF (TTL) file format that can be published via the VocPrez web delivery system code. The technical nature of the process is being made easier through new coding applications under development. The Australian geological surveys are intending to share and reuse vocabularies wherever possible and this is being governed through GGIC’s recently restarted Controlled Vocabulary Working Group.

- *Data Transfer Standards*

The GGIC Petroleum Data Working Group has developed a data transfer standard for petroleum and energy-related tenements (eg, exploration permits, production

licenses) – PetroleumTenementML
<https://schemas.geoscience.gov.au/?prefix=PetroleumTenementML/1.0/> So far,

New South Wales and Northern Territory have published web services using the new standard and other government agencies are developing PetroleumTenementML web services. The new data standard complements the existing MineralTenementML standard developed by GGIC in 2013.

In other Australasian data standards work:

- GGIC intend to complete the work on a shared data standard for delivering geochemistry data from all jurisdictions in 2023
- A data transfer standard for magneto-telluric data has been developed by Australian geophysicists in 2022.

- *FAIR compliance*

Geoscience Australia and GNS Science are both evaluating FAIR compliance and embedding the principles into organizational strategy and workflows. Progress was reported to the Geoscience Information Consortium annual meeting in Prague in June by David Lescinsky and Mark Rattenbury. The Interoperability Principle is well met by adoption of CGI standards into geological map products in both organizations.

- *AGSON*

The Australian Geological Survey Organizations Network (AGSON) portal is the renamed AusGIN government geoscience data and services access point <https://www.geoscience.gov.au/>. All Australian geological surveys contribute web services to the portal

- *New Data Releases*

The completion of the GeoMap geological data compilation of the Antarctic continent coordinated by GNS Science has been made possible with the cooperation of 18 key collaborators from geological surveys around the world (including Geoscience Australia) and the stewardship of the Scientific Committee for Antarctic Research. The GIS-based dataset is available through a web map application <https://www.scar.org/resources/geomap/> that utilizes CGI standards. The dataset is being prepared for OneGeology consumption.

(by Mark Rattenbury)

7.4 DDE Standards Task Group

With the strong support of CGI, CODATA and DDE, the CGI lead DDE Standards Task Group has made major contributions and achievements in 2022 in the geoscience standards for DDE program.

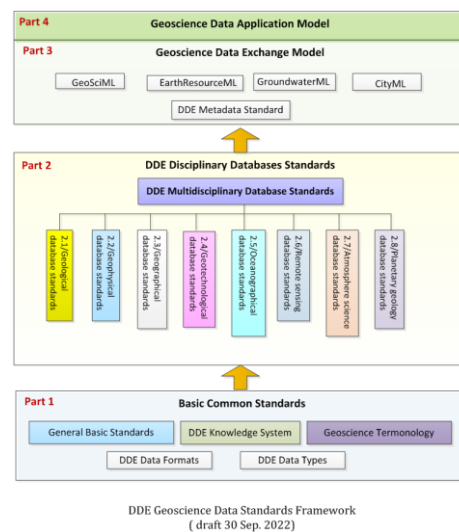
- *Main Achievements and Benefits to DDE*

The DDE-STG conducted many activities including coordination of the DDE standards

R&D project in 2022. Achievements included DDE knowledge system review procedure upgrading, DDE metadata standard draft circulation and the App development, DDE data evaluation guide draft version and supporting international release of DDE products.

- DDE-STG updated DDE knowledge system review procedures and provided advice to DDE WTGs on the knowledge system and graph construction methodology, science contents and functionalities. This helps DDE disciplinary knowledge system in Quality Control towards knowledge-driven discoveries.

- Apart from providing geoscience information standards from CGI/OGC GeoSciML and CGI EarthResourceML and China Geological Survey standards to the DDE WTGs, DDE-STG has also assessed standards requirements in 2022 for DDE WTGs and several geoscience domain organizations through meetings with DDE WTGs, such as meeting with DDE marginal seas group in March and informal standards meeting with seven DDE WTGs in July, and standards recommendations are provided to DDE WTGs on request. A general DDE geosciences data standards framework has been drafted, which consists of four parts, including an outline of corresponding disciplinary standards for DDE WTGs. of the framework provides guidelines on how to align DDE geoscience data standards with FAIR Principles and the pathway to harmonize distributed multidisciplinary DDE databases for data driven discoveries.



DDE metadata standard draft version update2 and the UI of the prototype App.

- On the basis of the in-depth training workshop for DDE-WGs in October 2021 with videos uploaded on DDE website (<https://ddeworld.org>), DDE-STG

provided consultation to DDE WTGs in 2022 on both disciplinary database development technology, and for data sharing methodology and standards.

- DDE-STG through the DDE standards R&D project circulated the DDE metadata standard draft revision for revision in 2022, and two updated draft versions were made in 2022 based on feedback from DDE-STG scientists and DDE WTGs. The revised version added three new elements (up to 42), an additional code lists (up to 12), and extended the topic categories up to 42 secondary codes for geosciences. Also in 2022, a prototype online App for the implementation of DDE metadata standard was developed, aimed at meeting Findable, Accessible and Reusable FAIR Principles, The App was made available in October 2022 for test at <https://metadata.deep-time.org>. The DDE metadata standard, customised for geological deep-time characteristics and rich classified geoscience categories that meet FAIR Principles, is anticipated will assist DDE WTGs in their metadata collection, release, and in catalogue and knowledge system construction.
- After a request from DDE, the standards project issued a draft in August 2022 of a General Guide for DDE Accessible Data Evaluations, based on ISO 19157:2013, FAIR Data Principles, OneGeology Web Services Accreditation Scheme, and current methods for DDE data resource access, with data authority, quality, volume, openness, service capacity and user scale taken into consideration.
- The DDE standards R&D project has also enabled DDE-STG and DDE secretariat to showcase results of the project and to promotion DDE products. The project introduction, products and activities news were put onto the DDE websites and CGI website for public review in 2022. The DDE metadata App has also been developed on the DDE website <https://metadata.deep-time.org> for both the WTGs scientists and for DDE metadata sharing, harvesting and reuse. Documentation of the DDE knowledge system review procedures is available on the DDE website. The DDE metadata standard, DDE accessible data evaluation, DDE geoscience data standards framework and other R&D documents will also be put on the website in due course for DDE scientists and the public.
- *Outreach*

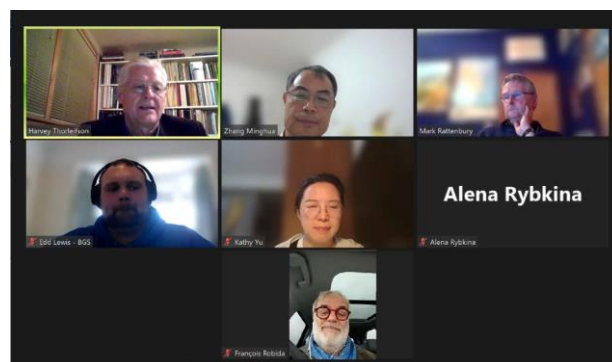
DDE-STG has been active in organizing meetings, seminars and workshops, both online and in-person, and also promotion through social media to enable closer collaboration with DDE WTGs and relevant organizations, and promote DDE products. Around 28 activities and events led by or attended by DDE-STG and the DDE standards R&D project include:

- DDE Geoscience Standards Training workshop follow up discussions and

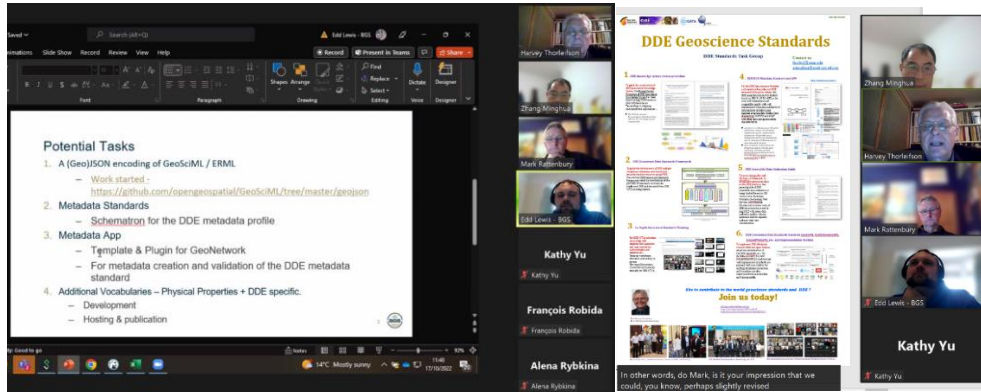
consultation to DDE WTGs since October 2021 to August 2022.

- DDE 3rd WTGs meeting on 14 January 2022.
- DDE Data Group meeting on 16 January, 23 January 2022.
- Meeting with DDE Magmatic Petrology Group on standards on 14 February 2022.
- DDE-STG meetings with DDE Marginal Seas group on 16 March 2022.
- Five meetings with DDE Data Group for geoscience disciplinary database development, 15 March, 22 March, 30 March, 13 August, 30 August 2022.
- DDE-STG meetings with DDE WTGs on geo-time scale on 9 April 2022.
- DDE standards meeting with DDE-China on 10 May 2022.
- DDE-STG leadership meeting, 23 June 2022.
- DDE Hangzhou meeting of WTGs, 3-6 July 2022.
- DDE standards meeting with DDE geological map group on 10 July 2022.
- Meeting with DDE petroleum group on knowledge graph on 22 July 2022.
- DDE WTGs meeting on Standards, 27 July 2022.
- Three meetings with DDE Data Group for DDE accessible data evaluation and feedbacks, 6 July, 6 August, 20 August 2022.
- Meeting with DDE Knowledge Group for DDE petroleum geology group knowledge work with standards on 28 August 2022
- Meeting with DDE Platform Group for DDE metadata App 10 September 2022.
- Meeting with DDE Knowledge Group for standards framework on 15 September 2022.
- Relevant meetings online, such as CGI Geoinfo Summit (March, May, September 2022)
- DDE-STG leadership meeting 30 October 2022.
- DDE update meeting in Paris on 7 November, 2022 in Paris.
- UNESCO-IUGS-DDE Open Science Forum in Paris on 9 November, 2022 in Paris.
- Side meeting with CODATA executive chair Simon Hodson on 9 November, 2022 in Paris.

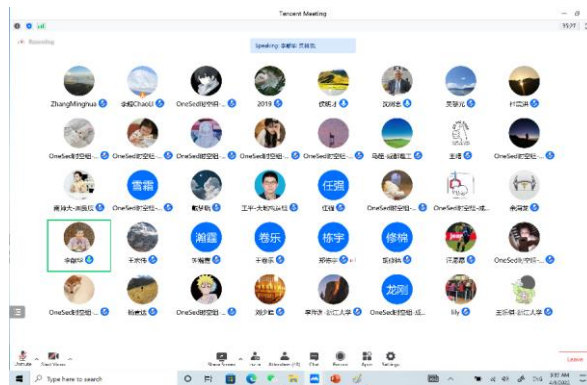
Pictures and screen shots of some events and online meetings are as below.



DDE-STG leadership meeting on 23 June 2022



DDE-STG leadership meeting online on 30 October 2022



DDE-STG attended the DDE geo-time meeting on 4 July,2022



DDE-STG meeting with DDE Marginal Seas Group on 16 March 2022.



DDE-STG hosted the DDE WTGs informal online meeting on 27 July 2022



DDE-STG and project products attended DDE update meeting on 7 November and UNESCO-IUGS-DDE Open Science Forum on 9 November in Paris

- *Problems and issues*

The pandemic affected DDE-STG and the project work, particularly in project scientists' communication that would have been conducted in-person in technical discussions for drafting standards which were delayed and prolonged. Connections with DDE WTGs on data standards will need to be strengthened.

Recruitment of capable experts faced difficulties in 2022 due to the pandemic, and funding limitations. Scientists and experts are needed badly with broad knowledge on data standards, information technology, and data science, who also are familiar with geoscience disciplines and existing CGI, OGC, ISO standards and well implemented global geoscience related programs and initiatives like OneGeology, EarthCube, USGIN, INSPIRE, EPOS, etc. It was also noted that capable experts were busy and in demand, while the DDE standards project funding was limited.

- *Further plans*

Much remains for DDE-STG and the project to fulfil, and some interim results require enrichment. In particular, the geoscience data standards framework requires revision in close collaboration with CGI, OGC, OneGeology, EarthCube, USGIN, and DDE data science group, data group, and knowledge group well.

In 2023, DDE-STG will continuously conduct training workshop for DDE WTGs on well implemented geoscience data standards such as CGI/OGC standards, to guarantee to the maximum extent that DDE WTGs scientists can work at high efficiency in development of machine-readable and FAIR data and knowledge. Also, flexible and effective mechanisms will be set for targeting and handling DDE WTGs requirements precisely and provide accurate advices to support DDE data exchange in FAIR.

From 2023 to 2024, DDE-STG and the project will mainly focus on delivery of three

products. The first is the DDE geoscience data standards framework that helps implement DDE towards FAIR and Open Science. The remaining two main tasks are to complete geoscience data standards of DDE based on GeoSciML, EarthResourceML and tool software, and to enhance cooperation with DDE-WTGs and CODATA on data FAIR through project collaborations and standards extensions.

(by *Zhang Minghua*)

8. Main problems encountered

The COVID-19 pandemic strongly affected CGI activities in 2022, particularly face to face meetings of the working groups and the council, and face-to face training courses and promotions as well. Recruitment, particularly of younger members has been another issue in recent years.

Global economic uncertainty has had strong impact on monetary support for regional activities of the CGI in 2022.

- Limited funding for completion of standards to support demand for comprehensive geoscience information issues is always a big challenge. Difficulties in cross-border communication and limited budgets for meeting organization is another challenge to maintain group cohesion and to stay informed on the issues that CGI member countries are struggling with.
- Some key members of working groups are nearing retirement. To find young geoscientists capable and willing to work on CGI standards is still a big issue.

CGI is considering to take measures to tackle the above issues. A suggestion of organizing regional or country sub-commissions maybe a way to attract the above issues.

The CGI Council acknowledges the financial restrictions on many representatives, and that travel expectations of council members should not be applied as strictly to them. CGI council members should attend annual meetings in person if it is possible.

Outreach activities are often being organized in an ad hoc way, based on any opportunities given, rather than on medium term planning and systematic strategic approach.

Careful arrangements have been established for opening IUGS-CGI bank accounts, to achieve robust expenditure approval and transparency, and to achieve efficiency in financial operations.

9. Annual Financial Report

9.1 CGI Council Grants

The two CGI Council Grants that were carried over into 2022 have been satisfactorily completed and final payments made on presented invoices.

The first completed was the multi-lingual vocabulary implementation and GitHub hosting of vocabulary services project awarded to the British Geological Survey for USD 10,000. The project resulted in many new multi-lingual terms to be added to existing vocabularies and a new GitHub repository for the storage of essential files and scripts for vocabulary publication in VocPrez. Documents relating to contract are stored in the Contracts folder in the CGI Council's Google Drive document repository.

The second completed project was to develop and document a process for publishing complex geology data features via docker image containerization and configure this in GeoServer. The contract was managed through Eric Boisvert (GSC) and awarded to GeoSolutions to deliver for USD 10,000. Documents relating to contract are stored in the Contracts folder in the CGI Council's Google Drive document repository.

A call for new CGI Council grant proposals was made in mid-2022 but no grants were awarded. Follow up discussions with the British Geological Survey on work relating to CGI-DDE vocabulary and a GeoJSON version of GeoSciML is expected to lead to a proposal and contracting early in 2023.

9.2 2022 Income and Expenditure Summary

Transactions in 2022 continue to be light owing to no face-to-face meetings of the CGI Council nor its working groups and general curtailment of travel due to the ongoing Covid-19 pandemic. Invoices and financial statements are stored in Finance folders in the CGI Council's Google Drive document repository.

Significant income

- IUGS's Deep-time Digital Earth Executive Committee awarded a grant of USD 10,000 for enabling DDE-Standards Task Group activities.
- IUGS awarded an annual grant of USD 10,000 for CGI operational activities.

Significant expenditure

- A final payment of USD 8,176.42 was made to GeoSolutions (Italy) for the CGI Council grant awarded for the interoperability containerization project.
- A final payment of GBP 7632 to the National Environmental Research Council (British Geological Survey) for the CGI Council grant awarded for multilingual and other vocabulary services.

- Payment to the National Environmental Research Council of USD 2000 was made for British Geological Survey contributor presentations to the DDE-STG training workshop in October 2021.

Summary of transactions

Transaction Date	Transaction description	Debit	Credit	Balance
1 January	Opening balance (New Zealand account NZD)			\$38,482.45
28 Feb 2022	Bank Charge	\$9.00		
28 Feb 2022	CGI Grant final payment to BGS (NERC)	\$15,527.34		
10 May 2022	IUGS annual grant		\$15,481.31	
10 May 2022	Bank Charge	\$15.00		
16 Sep 2022	DDE grant for DDE-STG activities		\$16,435.47	
16 Sep 2022	Bank Charge	\$6.00		
27 Sep 2022	Bank Charge	\$9.00		
27 Sep 2022	Bank Charge	\$31.92		
27 Sep 2022	DDE-STG 2021 workshop contributor payment to BGS (NERC)	\$3,612.91		
09 Nov 2022	Bank Charge	\$9.00		
09 Nov 2022	Bank Charge	\$35.20		
09 Nov 2022	CGI Grant final payment to Geosolutions	\$13,899.80		
31 December	Closing balance (New Zealand account NZD)			\$37,244.06

Closing balance is equivalent to USD 23,650 (as of 1 January 2023 NZD-USD exchange rate).

9.3 2023 Budget

Balance 1 January 2023 (USD)

\$23,650 Carried over from 2022

Income for 2023 (USD)

\$20,000 Requested 2023 funds from IUGS

\$10,000 DDE grant for 2023 for DDE-STG activities

Expenditure for 2023 (USD)

\$12,000 BGS contract for vocabulary and GeoJSON development (DDE-STG, to be confirmed)

\$3,000 Meeting room hire (face-to-face CGI Council and WG meetings in China)

\$3,000 CGI standards training honoraria for face-to-face event in China

\$10,000 CGI Grant funds for commissioned projects - proposal(s) to be sought

\$18,000 DDE-specific metadata and GeoNetwork parts of the BGS contract (to be confirmed)

\$3,000 [Travel to Africa for IUGS EC meeting in early 2024.](#)

Balance 31 December 2023 (USD)

\$4,650

(by Mark Rattenbury)

10. Work plan for next year

- Actively participate and play important roles in the IUGS DDE program through the DDE Standard Task Group, to both support DDE and to implement CGI standards towards FAIR and Open Science.
- Prepare the participation in 37 IGC 2024 in Korea for a symposium or sessions on geoscience information technology and standards related promotion and applications.
- Draft the strategy plan of CGI for the geoinformation revolution, and play the leading role in geoscience data and knowledge graph standards development and release for IUGS.
- Complete and circulate within IUGS and relevant organizations a draft 5-year plan of CGI.
- Continue to push forward the joint CGI/OGC Geoscience DWG work, especially a work plan for CGI within the DWG.
- Continue to push forward the implementation of OGC/CGI GeoSciML standard and to develop the schema in JSON.
- Continue the development and implementation promotion of EarthResourceML, especially ERML-lite for OneGeology.
- Consider how GeoSciML and EarthResourceML functions with OGC API suite of standards.
- Continue to develop and publish new geoscience vocabularies, improve existing vocabularies including the addition of multilingual terms.
- Actively communicate with CODATA for cooperation on supporting UNESCO Open Science policy.
- Continue to push forward promotion of CGI products and to draft a marketing plan.
- Update and enrich the CGI website with projects and working group activities updating and products promotion.
- Continue to publish the CGI newsletters regularly and to contribute to IUGS E-Bulletin.
- Take effective measures to publish more publications of CGI related issues within IUGS "Episodes".
- Organize a GIRAF workshop and a meeting at the 28th Colloquium of African Geology (28CAG) in 2023.

- Represent the IUGS in Geoscience information matters
 - Effective collaboration with CODATA in DDE Standards Task Group, DDE data FAIR use case project and more.
 - Enhanced relations with RDA.
 - More activities on geoscience information relevant to IUGS involved events towards UN Goals 2030 and ISC.
- Hold the next in person CGI annual meeting in 2023 in association with DDE training workshops on geoscience data FAIR in China, if the situation allows.

11. Critical milestones

- The Geoinfo Summit hosted by CGI on 24th Feb, 19th May, and the two days follow-up on 20th -21st Sep, 2022 attended by CGMW, CODATA, LOOP, OGC, DDE and OneGeology and several other relevant organizations, which outlined the developing trends of geoscience information and CGI strategy plan on a dynamic physical geoscience with integration of surveying, monitoring, and 3D/4D multi-disciplinary data and information, real time visualization and prediction.
- CGI co-host the DDE update meeting in Paris for a 3-year progress presentation, demonstration and issues discussion on 7th Nov 2022. CGI officials and key scientists participated this meeting and the following 9th Nov UNESCO-IUGS-DDE Open Science Forum at the UNSCO headquarters presented the importance of data standards and international cooperations.

12. Budget request for 2023 and potential funding sources

CGI Council requests a doubling of the IUGS allocation compared to the previous year 2022, \$20,000 USD, to enable the full implementation of the delivered interoperability projects in 2022 and one new project grants that assist both CGI's and DDE's geoscience information standards development. Additional resources will help support in-person meetings and workshops with DDE in China for geoscience standards training and strategy plan after three years of pandemic, which involve some top scientists to join, and to complete planned work in 2023 to support CGI activities as the commission for geoscience information of IUGS, such as coordination with partners, standards upgrade, to motivate efforts on collaboration and Open Science.

The increased allocation will also help CGI participation at the planned IUGS EC meeting in Africa in early 2024.

The DDE standards R&D project funding will continue to support the DDE Standards Task Group through involvement of CGI members in the project work.

CGI will continue to search for other financial support to the critical activities related to standards upgrade, extension and implementation, strategy development, and in person meetings of the council and working groups.

13. Objectives and work plan for the next 5 years

The CGI Council is in the process of updating the 5-year workplan. Some of the objectives currently and in the following years include:

- Actively participate in and support the IUGS DDE program by playing a leading role in the DDE Standard Task Group, particularly in the R&D project of Geoscience Information Standards for DDE which and in collaboration with CODATA and other relevant partners.
- Assist with a report to IUGS on the conduct of DDE-STG and the R&D projects following the DDE Medium Term Plan in 2024.
- Launch and complete CGI grant-funded projects with the British Geological Survey for implementing GeoSciML in GeoJSON, as well as documenting the new CGI vocabulary publication process and a new project on digital twins of dynamic physical geoscience.
- Play a more visible role in coordination of regional initiatives, e.g. by organizing workshop and training courses on geoscience information management and application, standards and language.
- Motivate and recruit capable people, especially younger scientists from both geoscience and IT backgrounds to work with CGI standards working groups and to undertake collaboration projects, including the DDE-STG project.
- Consider a mechanism of regional or country subcommittees and memberships for a way to tackle with manpower issue and attract more national organizations to contribute to CGI of IUGS.
- Review the scope and intent of the CGI working groups as data standards mature and new opportunities arise, for example, developing interoperability of 3D - 4D geosciences data models and geoscience ontologies, as well as geoscience knowledge graphs.
- Catalyze productive alliances between geoinformation bodies, including OGC, CODATA, RDA, and Linked Data.
- Promote international use of data exchange standards (especially broad adoption of GeoSciML, EarthResourceML and CGI geoscience vocabularies) in regions,

commissions, countries, and organizations in collaboration; Facilitate outreach, knowledge transfer and take-up of best practice in geo-information (e.g. with the South America initiative, the Asia initiative, and the GIRAF).

- Enhance collaboration with other IUGS commissions, e.g. ICS.
- Co-host a symposium or several sessions with CGMW, OneGeology, and DDE, etc. at the 37 IGC 2024 in Korea on geoscience information technology, data standards, digital twins, knowledge graphs, and AI applications in Earth sciences.

14. Suggestions for improvement of IUGS activities

It would be helpful if IUGS Council can continue to approve CGI's management and carryover of annual IUGS allocations over multiple years. This enables CGI to meet intermittent, larger expenditure items such as contracts for specific standards development work, website maintenance and a CGI presence at major conferences (e.g. IGC).

15. Conclusion

CGI was active, productive and much more visible in 2022, utilizing both in person and online means that have been dictated by the pandemic.

Excellent CGI leadership meetings on 30th August, 17th October and council meetings on 26th January, 12th April, 30th June and 26th October were held on important issues like CGI strategy, standards implementation, knowledge graph and data science trends and cooperation between partners. Grants were awarded to important projects to advance CGI goals. CGI co-hosted successful DDE update meeting on 7th November and attended the astonishing UNESCO-IUGS-DDE Open Science Forum on 9th November in Paris with geoscience standards be more and widely focused. And CGI successfully hosted the superb Geoinfo Summits on 24th February, 19th May, and the follow-up on 20-21 September, 2022 which attended by CGMW, CODATA, LOOP, OGC, DDE and OneGeology and several other relevant organizations. CGI also issued excellent newsletters in 2022.

The CGI-led DDE-STG and the DDE standards R&D project on Geoscience Information for DDE have been a pillar supporting DDE data going FAIR and knowledge system construction. Stronger collaborations with CODATA and relevant organizations also started in 2022 for DDE data standards enrichment and applications to meet the Open Science demands and towards data and knowledge driven geosciences.

The ambition of the CGI is to pursue its approach of developing standards for FAIR and Open geoscience data resources, by taking into account current technologies and new methodologies for the future, such as, semantic web, linked data, digital twins, OGC apps, big data, artificial intelligence, knowledge graph, and more.

To do this it seems important to maintain and strengthen links:

- with **scientific communities**, in the field of geosciences, with the support of geological survey and geoscientific organizations, through presence in major international or continental projects (DDE, OneGeology, EPOS, AuScope, ...), and also with other disciplines through CODATA and the RDA for example,
- with the **geoscience industry**, a major producer of data, to promote their adoption of CGI standards,
- with the **IT and data science sectors**, the powerful and efficient tools and supports to the data-driven and knowledge-driven geosciences,
- with the other actors of standardization in the digital domain such as OGC or W3C (semantic web),
- with software developers to encourage and facilitate their implementation of CGI standards,
- with the communities of geoscientists around the world to push the deployment of these standards.

To achieve these ambitions, it is of primary importance to maintain and renew the expertise available to CGI by reinforcing necessary skills and people in new technologies.

Finally, CGI would like to express its thanks to all members of the CGI and its regional groups and working groups, and also to the members of the IUGS Executive Committee for their help and encouragement as always. We are very much looking forward to continuous and more productive cooperations in 2023, marking the post pandemic rebounds of the global economy and geological science information specifically.

CGI Council, 16 January, 2023

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