CGI ANNUAL REPORT 2019

Commission for the Management and Application of Geoscience Information

Content

1. Main role of CGI

- *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,
➢ the benefit of all society.

2. Role within IUGS science policy

The 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 several significant positions within the international geosciences information community.

3. Organization, Council members and officers

- *Council Officers 2017-2020*

The CGI Council members are:

- François Robida (Chair) – France
- Zhang Minghua (Co-Secretary General)– China
- Kombadayedu Mhopjeni (Co-Secretary General)– Namibia
- Ollie Raymond (Treasurer and Web Manager)– Australia
- Gabriel Asato – Argentina
- Kazuhiro Miyazaki – Japan
- Tomasz Nałęcz - Poland
- David Percy – USA
- Harvey Thorleifson–USA
- Robert Tomas –Czech Republic
- Eric Boisvert–Canada

The Council has representatives from all continents. The list of contacts is given in Appendix.

CGI Council meeting – Madrid May 2019

The current CGI secretariat is located at the Development Research Center of China Geological Survey, Ministry of Land and Resources, P. R. China (DRC of CGS). The contact email is CGIsecretariat@mail.cgs.gov.cn.

The CGI working groups are coordinated by:

o GeoSciML Working Group (GeoSciML) – Eric Boisvert, Canada

o EarthResourceML Standard Working Group (ERML) – Jouni Vuollo, Finland

o Geoscience Terminology Working Group (GTWG) – Mark Rattenbury, New Zealand

o GeoScienceDWG Working Group – Mickael Beaufils , France

o Geoscience Information in Africa – Network (GIRAF) –Mesfin Wubeshet Gebremichael, Tanzania

4. CGI online presence

CGI maintains several websites, online newsletters, a LinkedIn group, and online file repositories for its Working Groups. The main CGI website, online newsletters, and LinkedIn group are addressed in this report. The CGI Working Group reports will address their specific online resources.

The major redevelopment of the CGI website in 2019 is mainly to focus on CGI activities and major events and news of globe geological science information and news from IUGS.

- CGI Website – *www.cgi-iugs.org*

- CGI Newsletter
- CGI LinkedIn group (http://www.linkedin.com/groups?gid=6539642) is used
- CGI Working Groups : all CGI working groups maintain web pages for collaborative work and services:

GeoSciML	http://www.cgi-iugs.org/tech_collaboration/geosciml.html
EarthResourceML	http://www.cgi-iugs.org/tech_collaboration/earthResourceML.html
GeoScience Terminology	http://www.cgi-iugs.org/tech_collaboration/geoscience_terminology_working_group.html
GeoScienceDWG	http://external.opengis.org/twiki/GeoScienceDWG/WebHome

- *Membership*

CGI now has 515 members in 78 countries across the world. There is big increase of 52 new members in 2019 from some 20 different countries.

5. Extent of support from sources other than IUGS

Other than the substantial in-kind contribution of the geological organizations that pay the salaries and expenses of CGI Council and members, the CGI does not receive additional support. Sometimes CGI workshops and activities are co-organized or supported by other organizations such as UNESCO, geological survey of Canada, China geological survey, the German federal ministry for economic cooperation and development (BMZ), the Geological Survey of Namibia, Australian Aid, SEGEMAR, the United Nations Development program who have been contributing to these events.

6. Interaction with other international organizations

- *CGI collaboration with OGC*

The CGI, in collaboration with OGC, is continuing to review GeoSciML. Both the linked global OneGeology project and the past European EC project OneGeology-Europe are using GeoSciML to make geological data interoperable and accessible via their web portals. The EC Directive INSPIRE used for the Geology and Mineral Resources Implementing Rules CGI products: the GeosciML and Earth Resource ML (ERML) data model and CGI vocabularies. ERML was adopted by major EU funded projects as Mineral4EU or EURare.

The GeoSciML are now hosted on the OGC GeoSciML website. The original CGI GeoSciML website still maintains access to all historic versions of GeoSciML and links to other supporting resources like UML models and vocabularies.

- *CGI-YES Competition Award on IUGS-CGI Standards for Geoscience Data*

CGI and the Young Earth Scientists (YES) Network is offering an opportunity for a passionate geoinformatics professional to present their application of CGI standards at the 36th International Geological Congress in Delhi in March 2020. CGI will pay the successful applicant up to USD 2000 towards the cost of travel and accommodation at the IGC in Delhi. Registration cost

is covered by the YES Network. The final winner is Dr. Cao Yaqin from Jilin University, China.

- *CGI and CODATA*

CGI standards is presented at the CODATA 2019 conference in Beijing in Oct. titled The geoscience standards factory: the successful experience of IUGS/CGI and OGC by François Robida, Zhang Minghua, et al. And CGI take this opportunity to discuss with CODATA leaders for the cooperation in geoscience standards and joint work for DDE needs for standards.

7. Chief accomplishments and products

7.1 CGI News

- *CGI as funding member of IUGS recognized big science program DDE and the setting up of DDE Standard Task Group*

CGI is one of the founding members of the IUGS flagship project, recognizing the importance of standards in the building of this large international initiative which has been kicked off in February 2019 and will last of for 10 years since 2019 through 2028.

CGI attended the DDE Accord signing ceremony in Beijing on 26 Feb.2019.

The expertise of the CGI in the construction of new standards is strongly awaited by the promoters of the project, in order to allow the adaptation of existing standards or the development of new standards necessary for new type of data. As such, the CGI has been invited to participate through the presence of some of its experts at the DDE Standard Task Group. And some 14 CGI member geoscientists including a few councilors are now joined to work for this Task Group.

A meeting has been organized between CGI, CODATA and DDE secretariat in Beijing for this group setting up in Oct 2019 at the occasion of the 2019 CODATA Conference, and a face to face meeting of this task group will be held in Beijing on 12-13 January

2020, just before the IUGS-EC meeting to discuss the group work plan and review knowledge system documents submit by some 20 DDE disciplinary work groups.

DDE Standard Task Group setting up meeting(left) and CGI meeting with CODATA and DDE secretariat on 20-21 Oct. 2019 in Beijing. (from left to right: Zhang Minghua-CGI, Cheng Qiuming-IUGS, Francois Robida-CGI, Fan Junxuan-DDE, Li Jianhui-CODATA, Alena Rybkina-CODATA, Francois Robida-CGI, Zhang Minghua-CGI)

- *CGI-IAMG-OneGeology-CCOP symposium at 36th IGC*

With officers acted as the main conveners, CGI is now in charging of organization of a symposium at 36th IGC in Delhi under the theme of IUGS with the number 45.10 and the title of Advances in Geoscience Data Sharing and Processing.
The symposium has received and viewed 29 submit abstracts with 24 accepted and 18 for oral presentation. This symposium will focus on application of CGI-IUGS/OGC standards in global and regional data sharing and analysis, advances in, and application of, the OneGeology initiative, new research and achievements in mathematical geoscience, AI and other new technology application in geoscience data processing.

- *CGI standards promotions*

CGI standards were introduced to scientists, geologists and officials of science and geoscience organizations and at several events and training courses in 2019, such as CODATA conference, DDE working meetings, CCOP annual session, and Chinese training courses on geoscience information for developing countries, etc.

7.2 Working Group Reports

7.2.1 GeoSciML Standards Working Group

- *Membership and repository*

The official OGC GeoSciML Standards Working Group (SWG) membership stands at 36 members and observers. The public GeoSciML mailing list has 77 registered Members from Australia, Austria, Belgium, Canada, China, Czech Republic, Finland, France, Germany, Italy, Japan, Netherlands, New Zealand, Poland, Portugal, Russia, Sweden, UK, and USA.

GeoSciML schemas on OGC public schema site is at
http://schemas.opengis.net/gsml/4.1/. The GeoSciML SWG's GitHub repository provided by OGC at https://github.com/opengeospatial/GeoSciML. Sylvain Grellet (BRGM) and Eric Boisvert (GSC) have management privileges.

- *Meetings and activities*

There was little direct GeoSciML activities during 2019. The only meetings were at OGC TC in Leuven and Toulouse to report on activities related to GeoSciML. For logistic reasons, a meeting could not be organised in Madrid around GIC . The Open Geospatial Consortium is reviewing how groups operate and proposes to assign each SWG (Standard Working Group) to a DWG (Domain Working Group).   The proposal is to host GeoSciML under the GeoScience DWG. It was originally under the ESS (Earth Science System). The SWG comprises 51 members, based on the GeoSciML mailing list.

As reported at the Toulouse OGC TC during the GeoSciML Standard Working Group meeting, GeoSciML is mostly in maintenance mode. There are a few change requests logged through different media: OGC Change Request system, GeoSciML Github issue and emails.   Most of the changes are minor fixes, typos, and missing pieces that do not otherwise change the model.   The main changes are backward compatible.   As there are several existing WFS services running on GeoSciML 4.1, we try to avoid frequent changes to the model and wait for a single major update. Therefore, some of those change requests are parked waiting for a new version.
There are requests to add new "lite" (a.k.a Portrayal) views (TimeScale) and update lite to GML 3.2 (to comply with WFS 2.0).   Other requests deal with alternative encodings – which does not affect the GeoSciML conceptual model per se. An email has been circulated to the SWG in late November to seek advice and interest into pushing changes to a new version.
One activity that has potential to trigger changes to GeoSciML is the Borehole Interoperability experiment (IE) (https://github.com/opengeospatial/boreholeie). The IE, lead by BRGM (France), worked with government, academic and private sectors representatives from Australia, Germany, Sweden, UK and Canada to experiment with a core model for Borehole. The Engineering report (OGC 19-075r1, https://portal.opengeospatial.org/files/?artifact_id=90978) was released to OGC for the Toulouse TC.   The report is not a standard, but recommends the creation of a working group to move toward that goal. The publication of such a standard might trigger a revision of existing borehole standards, including the GeoSciML borehole package.

The other categories of activities do not affect the model itself, but reflect a

technological shift on how data is used, namely by machine learning and artificial intelligence. The emergence, and fast growth, of those technologies pressure geoscience information providers to feed the data-hungry algorithms with data and knowledge. The Second Environmental Linked Features Interoperability Experiment (SELFIE) https://www.opengeospatial.org/projects/initiatives/selfie, and LOOP3D (https://loop3d.org/) in partnership with OneGeology, are driving the need for a knowledge encoding (OWL/RDF) of GeoSciML. The ontology community, active in LOOP, but also across the world (e.g. https://doi.org/10.1016/j.cageo.2018.04.001), is leveraging the GeoSciML model and vocabulary – with strong emphasis on the latter - in an attempt to encode geoscience knowledge. The result blurs the line between "model" and "vocabulary". Loop3D activities are currently restricted to members, but will be open to the public soon.

OGC is also shifting its current API from Service Oriented Architecture (RPC style) to Web-Oriented architecture (REST). Although the new API does not prescribe any encoding, web developers tend to favor JSON based encoding. There are some aspect of the API regarding organisation of collections that may raise packaging issues.

- *Uptake*

This section is far from complete, and just shows some examples of impact of GeoSciML.

There is an increasing amount of GeoSciML based web services, mostly because of OneGeology and INSPIRE and spinoff projects (such as EPOS https://www.epos-ip.org/tcs/geological-information-and-modeling/data-services/wp15-services-and-architecture) and large initiative such as GeoEra (http://geoera.eu/), USGIN (http://usgin.org/) , and GIN (http://gin.gw-info.net), etc... GeoSciML lite is by far the most popular because of its simplicity. This sends a strong message that simple models are needed, at least for initial implementation. Something GWML should consider.

GeoSciML is also a conceptual model and is used as a starting point for domain specific modelling – similar to GWML, SoilML and ERML. Papers on Plate Tectonic reconstruction and Geological Hazard are published can be found on the web. The SWG has been contacted for similar interests from engineering geology.

The emerging focus is to build knowledge representations (such as OWL) while several projects look into encoding vocabularies to enable machine reasoning and linked data applications.

- *Future work*

There are several avenues of activity to consider, too many to effectively pursue with our collective dwindling resources. There is a need to scope the objectives of the working group in light of the new reality;

- Go forward with standing issues and release a new version of the model. Nothing in the queue will break the current model.

- The modelling exercise is shifting to ontologies. This has been identified at the Vancouver meeting (2018). Some work is underway (Loop and Minerva, amongst others).

- Work on encodings (RDF and JSON). These are generally straightforward tasks that require minimal resources.
- Expand GeoSciML to 3D, although it is not clear how this will affect the model (waiting for Loop3D)
- Explore deployment of GeoSciML on the new OGC API.

(by Eric Boisvert)

7.2.2 Geoscience Terminology Working Group

- *Membership*

The membership of the group has 28 members. 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.

- *Meeting and Activities*

The 2019 face-to-face meeting was held at the Geological Survey of Spain (IGME) offices in Madrid on 3 May. Five were present in person (four GTWG members) and two attended remotely. The GTWG activities are described under link from CGI's website, simplified and updated in late 2016, http://www.cgi-iugs.org/tech_collaboration/geoscience_terminology_working_group.html   and from the GeoSciML website at http://www.geosciml.org/.

- *Achievements*

Five vocabularies have been voted for adoption: collectionTypeValue, amountEstimationMethod, compositionEstimationMethod, oreMeasureType, regionalLithologicUnitSynthesis.
Two published vocabularies commodityCode and simpleLithology have had new terms accepted for addition.
Many vocabularies are in advanced draft form but are still awaiting completion; naturalGeomorphologyFeature, mineralDepositType, geoscientificThemes, processingActivityType, processingTransformationPlant, wasteType, resourceEvaluationMethod, specimenType, materialClass, samplingMethod, boreholePurposeTerms, eventEnvironment and eventProcess.
The vocabulary host service has been managed by Geoscience Australia. Teething issues and service dropouts reported previously have prompted GA to move the vocabulary service from a SiSSVoc instance to a cloud-based VocPrez instance. This is anticipated to simplify vocabulary uploading and maintenance as well as much more service stability.   The CGI-IUGS vocabularies are all published for general discovery in

the Australian National Data Service (ANDS)'s Research Vocabularies Australia (RVA) Portal:
https://vocabs.ands.org.au/search/#!/?p=1&publisher=CGI%20Geoscience%20Termi nology%20Working%20Group&q=

Particular thanks are due to Ollie Raymond and his GA team for making their server facilities available for CGI.

VOCABULARY	#terms	De	Es	Fi	Fr	Id	It	Ja	Km	Ko	Lo	Ms	Nl	Ru	Sv	Th	Us	Vi	Zh
alterationType	24	4%	4%	4%	8%	8%	4%	8%	8%	8%	8%	8%	0%	4%	4%	8%	0%	8%	8%
boreholeDrillingMethod	30	7%	7%	7%	0%	0%	7%	0%	0%	0%	0%	0%	0%	7%	10%	0%	0%	0%	0%
commodityCode	293	60%	60%	60%	64%	64%	60%	64%	64%	64%	64%	64%	2%	60%	60%	64%	0%	64%	64%
compositionCategory	75	12%	12%	12%	13%	13%	12%	13%	13%	13%	13%	13%	0%	12%	12%	13%	1%	13%	13%
compoundMaterialConstituentPartR	35	17%	17%	17%	11%	11%	17%	11%	11%	11%	11%	11%	3%	17%	17%	11%	0%	11%	11%
consolidationDegree	13	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
contactType	36	3%	3%	3%	0%	0%	3%	0%	0%	0%	0%	0%	0%	3%	3%	0%	0%	0%	0%
conventionCode	2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
deformationStyle	3	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	0%	33%	33%	33%	0%	33%	33%
earthResourceExpression	7	29%	29%	29%	14%	14%	29%	14%	14%	14%	14%	14%	0%	29%	29%	14%	0%	14%	14%
earthResourceForm	10	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	0%	30%	30%	30%	0%	30%	30%
earthResourceMaterial	7	57%	57%	57%	29%	14%	57%	14%	14%	14%	14%	14%	14%	57%	57%	14%	0%	14%	14%
earthResourceShape	7	57%	57%	57%	0%	0%	57%	0%	0%	0%	0%	0%	0%	57%	57%	0%	0%	0%	0%
endUsePotential	30	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%	3%	23%	23%	23%	0%	23%	23%
environmentalImpact	32	34%	34%	34%	31%	31%	34%	31%	31%	31%	31%	31%	0%	34%	34%	31%	0%	31%	31%
eventEnvironment	146	24%	24%	24%	8%	8%	24%	8%	8%	8%	8%	8%	2%	24%	24%	8%	0%	8%	8%
eventProcess	81	38%	38%	38%	32%	32%	38%	32%	32%	32%	32%	32%	1%	38%	38%	32%	0%	32%	32%
explorationActivity	27	22%	22%	22%	7%	7%	22%	7%	7%	7%	7%	7%	4%	22%	22%	7%	0%	7%	7%
explorationResult	12	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
faultMovementSense	13	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
faultMovementType	15	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
faultType	23	24%	24%	24%	16%	16%	24%	16%	16%	16%	16%	16%	0%	24%	24%	16%	0%	16%	16%
featureObservationMethod	16	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
foliationType	74	12%	12%	12%	7%	7%	12%	7%	7%	7%	7%	7%	0%	12%	12%	7%	0%	7%	7%
geneticCategory	32	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
geologicUnitMorphology	77	19%	19%	19%	5%	5%	19%	5%	5%	5%	5%	5%	0%	19%	21%	5%	0%	5%	5%
geologicUnitPartRole	24	21%	21%	21%	17%	17%	21%	17%	17%	17%	17%	17%	4%	21%	21%	17%	0%	17%	17%
geologicUnitType	20	15%	15%	15%	0%	0%	15%	0%	0%	0%	0%	0%	0%	15%	15%	0%	0%	0%	0%
lineationType	22	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	0%	5%	5%	5%	0%	5%	5%
lithology	263	41%	41%	40%	37%	37%	40%	37%	37%	37%	37%	37%	1%	40%	41%	37%	0%	37%	37%
mappedFeatureObservationMethod	27	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
mappingFrame	4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
metamorphicFacies	13	0%	0%	0%	15%	15%	0%	15%	15%	15%	15%	15%	0%	0%	0%	15%	0%	15%	15%
metamorphicGrade	9	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
mineStatus	13	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	0%	15%	15%	15%	0%	15%	15%
mineralOccurrenceType	7	43%	43%	43%	14%	14%	43%	14%	14%	14%	14%	14%	0%	43%	43%	14%	0%	14%	14%
miningActivity	14	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	0%	21%	21%	21%	0%	21%	21%
miningProcessingActivity	39	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	31%	0%	31%	31%	31%	0%	31%	31%
particleShape	12	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
particleType	62	18%	18%	18%	13%	13%	18%	13%	13%	13%	13%	13%	0%	18%	18%	13%	0%	13%	13%
planarPolarityCode	3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
proportionTerm	10	10%	10%	10%	0%	0%	10%	0%	0%	0%	0%	0%	0%	10%	10%	0%	0%	0%	0%
rawMaterialRole	3	100%	100%	100%	100%	67%	100%	67%	67%	67%	67%	67%	33%	100%	100%	67%	0%	67%	67%
resourceAssessmentCategory	7	14%	14%	14%	0%	0%	14%	0%	0%	0%	0%	0%	0%	14%	14%	0%	0%	0%	0%
unfc	12	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	0%	8%	8%	8%	0%	8%	8%
wasteStorage	4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
lsChart	177	59%	59%	59%	57%	57%	59%	57%	57%	57%	57%	57%	0%	59%	59%	57%	0%	57%	57%
stratigraphicRank	18	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
valueQualifier	9	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
classificationMethodUsed	14	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
descriptionPurpose	4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
determinationMethodOrientation	8	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
particleAspectRatio	17	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
reserveAssessmentCategory	3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Key for translation completion	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Summary status of translated terms for 18 languages for 54 CGI vocabularies.

The multi-lingual translation of terms resulting from CGI-funded work undertaken by BGS require checking by geological survey staff for each language as some spelling errors and redundant terms were identified. As a priority the simpleLithology and commodityCode list will be circulated to geological surveys contacts for their review, prior to upload of the alternate terms to the the SKOS RDF files. There are many terms missing in many vocabularies for 18 languages (Fig. 1), many vocabularies have not been translated into any language to our knowledge and many languages are missing

altogether.

- *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 prioritised. The EarthResourceML data model still requires the key but problematic mineralDepositType vocabulary and   the Madrid meeting has proposed a renewed push involving GTK, GA, the British Columbia Geological Survey and possible involvement of Minerva Intelligence, a Canadian-based mineral industry consultancy specialising in the application of geoscience semantics technology.

Working group activity outside of weeks preceding and following face-to-face meetings is still unsatisfactorily low. The winding down of INSPIRE work activity has removed much of the funded impetus for this work. Participation in vocabulary development is possible when the work is supported by the member's organisation and even then it may be difficult to make progress if fellow GTWG collaborators are unavailable. The co-alignment with other meetings such as CGI Council, GeoSciML SWG, ERML WG and GIC helps to increase GTWG participation level over that period, but typically this is not sustained for long as members' other work reassumes priority.

(by Mark Rattenbury)

7.2.3 EarthResourceML(ERML) Standards Working Group

This ERML SWG-report covers the period from November 2018 to December 2019.

- *Membership*

The EarthResourceML Working Group (ERML WG) has c. 10 active members (2018-2019):

• Jouni Vuollo	GTK – Finland (Chair)
• Daniel Cassard	BRGM – France
• James Passmore	BGS – Great Britain
• Michael Sexton	GA – Australia
• Ollie Raymond	GA – Australia
• Katarzyna Sadlowska	Poland Survey
• Mark Rattenbury	GNS – New Zealand
• Wang Yongzhi	Jilin University - China
• Cui, Yao	British Columbia - Canada

ERML SWG members attended one face-to-face meeting in Madrid, Spain 6th May 2019 hosted by IGME (the Spanish Geological Survey). The meeting was held after the meetings of the Geoscience Terminology Working Group (GTWG) in connection with the meeting of GIC. Six were present in person and two attended remotely.

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- *Meetings and activities*

The ERML activities are described under link from CGI's website, simplified and updated in late 2018, http://www.cgi-iugs.org/tech_collaboration/earthResourceML.html and ERML work from http://www.earthresourceml.org/. Common vocabulary work for ERML and GeoSciML from GTWG website at http://www.cgi-iugs.org/tech_collaboration/geoscience_terminology_working_group.html.

Promotion of CGI and especially ERML work:

- 12th FEM 2019 - https://femconference.fi/
  - Invited presentation - https://drive.google.com/file/d/1yD1Esgeo7L9XDA280JU_ORtXKJeXGtQH/view
    - "Onegeology global mineral resource services – Finnish, Australian, British/European and Canadian Surveys" by James Passmore (BGS)
  -
- RDA 14th meeting at Helsinki - https://www.rd-alliance.org/plenaries/rdas-14th-plenary-helsinki-finland
  - Poster session presentation - https://www.rd-alliance.org/14th-plenary-poster-session
    - "IUGS/GCI Global Geoscience Data Transfer Standards - GeoSciML and EarthResourceML" by Jouni Vuollo (GTK); Eric Boisvert (GSC), Mark Rattenbury (GNS) and CGI Interoperability Working Groups

- *Data Model Development and Documentation*

The ERML conceptual model
Version 2.0 of the CGI data standard for mineral occurrences and mines has been published 2014 see - http://www.earthresourceml.org/. After small modifications (2015-16) ERML is now fully compatible with the requirements of the European Commission's INSPIRE data specification for Mineral Resources.

In particular, important communities such as INSPIRE and Minerals4EU project provided valuable feedback to develop ERML 2.0 model and now ERML 2.0 is the preferred standard for mineral resource data sharing projects EURare, Minerals4EU, and ProSUM projects, and the Australian AuScope, and Geoscience Portal projects.

EarthResourceML Lite v. 1.0 version was accepted August 2016 and released August 2016. ERML Lite delivers a simplified flat view of key elements of the full ERML data model. New version of ERML Lite v. 2.0.1 was published September 2018. It can be used to standardize delivery of mineral resource data via Web Map Services (WMS) and simple features Web Feature Services (WFS SF0). Geological Surveys in Australia

and New Zealand have also endorsed the ERML Lite standard for delivery of mineral occurrence data.

- *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*

It is pleasing to note that there has been wide uptake of the ERML data standard in national and provincial Geological Surveys (Australia - Europe), mainly through its adoption by data sharing communities such as OneGeology, AuSGIN, INSPIRE/Minerals4EU and EGDI. In the short term, the major challenge is to get USGS/USA and GCS/Canada to join as active participants to develop/implement the ERML standard. Recently the Chinese organizations and British Columbia Survey from Canada have been activated to join our SWG.

New version of OneGeology portal (published early 2019).Data sets are from Circum Arctic and Fennoscandian area and British Colombia, Canada and are based on ERML Lite 2.0.1 data model.

The first steps to "Global Mineral Resource" service will be OneGeology portal and the thematic layer of Mineral Resources (early 2019) – see picture below and OneGeology 1/2019 newsletter "EarthResourceML-Lite WMS and simple feature WFS layers Author: James Passmore — OneGeology administraon technical lead; Jouni Vuollo (GTK)" http://www.onegeology.org/docs/onegeology_Newsletter_Issue_19.pdf.

- *Work planned*

Future development of ERML and ERML Lite will be undertaken by the ERML Working Group based on the feedback from use of ERML v2.0 like Minerals4EU and ProSum projects. The next versions of ERML v.3.0 will be published in 2020.

"The EarthResourceML data model still requires the key but problematic mineralDepositType vocabulary and the Madrid meeting has proposed a renewed push involving GTK, GA, the British Columbia Geological Survey and possible involvement of Minerva Intelligence, a Canadian-based mineral industry consultancy specialising in the application of geoscience semantics technology (from GTWG 2019 report)".

Plans for IGc36th in March 2020 at New Delhi is ongoing and new services to OneGeology Mineral Resource service is in progress (e.g GeoScience Australia).

(by Jouni Vuollo)

7.2.4 Report of the Joint CGI/OGC Geoscience Domain Working Group

Following its official creation in September 2017, several sessions of GeoScienceDWG were held in 2018 and 2019. Several use cases have been identified and are addressed by the 15 participants of the initiative.

- *The Borehole Interoperability Experiment (Borehole IE)*

The Borehole IE is defining a domain neutral semantic for a general concept of borehole and its associated data. It has drafted a public OGC engineering report on the OGC pending documents *https://github.com/opengeospatial/boreholeie/tree/master/er* summarizing the overall cross-domain, inter-standard findings and recommendations for a best practice implementation that should follow.

About Borehole IE: *https://github.com/opengeospatial/boreholeie*
Resources: *https://github.com/opengeospatial/boreholeie/*
http://www.opengeospatial.org/projects/initiatives/boreholeie

(by Francois Robida)

7.3 CGI Regional Group Reports

7.3.1 CGI in Asia

- *Meetings and activities*

Geological science information is one of the most active areas in Asia 2019. There are

more than 10 projects of regional geo-information cooperation implemented or continuously conducted this year, which is mainly Lead China, Japan and Korea.

China Geological Survey (CGS) has been continuously conducted several regional cooperation projects in 2019 in Asia. Typical activities are digital geological mapping (DGM), integrated geological data processing (IGDP) and cross border geoscience map compilation.

The Geological Survey of Japan (GSJ) is leading in implementation three major project related to geoinformation processing, storage and sharing system using OGC-based web services and Open Source Software (FOSS), OneGeology-Asia, CCOP Geoinformation Sharing infrastructure for East and Southeast Asia (GSi), and Asia-Pacific Region Global Earthquake and Volcanic Eruption Risk Management (G-EVER).

Korea Institute of Geoscience and Mineral Resources (KIGAM) developed the standardization guidelines for geological information such as geological symbols and rock units based on KIGAM's information and geosciences data repository (GDR) system as a geological resource research data platform.

(1) GeosciML implementation in China
China geological survey has translated CGI/OGC standard GeoSciML4.1 into Chinese and was uploaded to the OGC website for download. In 2019, CGS has started implementation GeoSciML 4.1 to release geological map data.
http://www.geosciml.org/doc/geosciml/4.1/documentation/ogc_spec_translations/16-008_OGC_

(2) Trilateral geoscience cooperation meeting among CGS, GSJ and KIGAM
A Trilateral meeting on geoscience cooperation among CGS, GSJ and KIGAM was held in Chiang Mai, Thailand on 6 Nov. 2019. The meeting agreed to push forward cooperation projects on geoscience information system and coast zone study. A following workshop in Daejeon, Korea on 17 December, 2019 was focused on 3D geological information related urban geology and engineering cooperation with participation of KIGAM, CGS, GSJ and British geological survey, geological survey of finland.

Trilateral meeting on geoscience cooperation among CGS, GSJ and KIGAM
on 6 Nov.2019 in Chiang Mai, Thailand.

(3) OneGeology Covering East Asia

The GSJ is continuously implementing the OneGeology project in cooperation with CCOP and its member countries. Most of WMSs of the geological maps of the countries in East and Southeast Asia are hosted by GSJ servers. WMSs of the geological maps of Indonesia, Malaysia, Vietnam, Myanmar, Philippines and Papua New Guinea were newly added to the list last October, 2019 at 1:1M, and geological map of Mongolia and the 1:200K seamless geologicalmMap of Japan V2. GSJ is also waiting for the approval for OneGeology registration the 1:10M Geological Map of Asia,1:10M Plutonic and Volcanic Rocks of Asia, 1:10M Earthquake Source Region of East Asia, 1:10 Tephra Fall of East Asia, 1:200K Abashiri Hokkaido Geological Map and 1:20K Suwanosejima Volcano Geological Map. The OneGeology covering East Asia website is now moved to the GSi system and the site's new URL is https://ccop-gsi.org/gsi/onegeologyasia/index.php.

(4) China-ASEAN Geosciences Cooperation Center established

On November 15, 2018, senior officials of mineral departments from China, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Thailand and Vietnam presented the inauguration ceremony for the "China-ASEAN Geoscience Cooperation Center" during the 9th China-ASEAN Mining Cooperation Forum in Nanning of China, which has marked a new milestone in geoscience cooperation between China and ASEAN member states. A seminar on geoinformation had also held on demonstration of the achievements of the geoscience information and cooperation.

The Inauguration ceremony of the China-ASEAN Geosciences Cooperation Center on 15 November, 2018

(5) CCOP Geoinformation sharing infrastructure for East and Southeast Asia (GSi)

The project is implemented by CCOP and GSJ. The main objective of the project is to develop a web-based system for the sharing of geoscience information among the countries in the Asia-Pacific region. Currently, CCOP and GSJ provide the servers to host the GSi main portal site and the database. The 4th International Workshop on CCOP Geoinformation Sharing Infrastructure (GSi) for East and Southeast Asia Project was held in Siem Reap, Cambodia from October 1 to 3, 2019. A joint meeting on CCOP Geoscience Data Repository (GDR) and GSi projects was held on Nov. 4, 2019, a side session at the 55th CCOP Annual Session in Chiang Mai, Thailand. The possible collaborative activities between the two projects were discussed during the meeting. The GSi system currently shares more than 770 maps data. New modules for pop-up information function, exterternal WMS access, geotif data upload and field data capture were developed and incorporated in the system.


Participants of the 4th CCOP GSi International Workshop in Siem Reap, Cambodia
The GSi main site
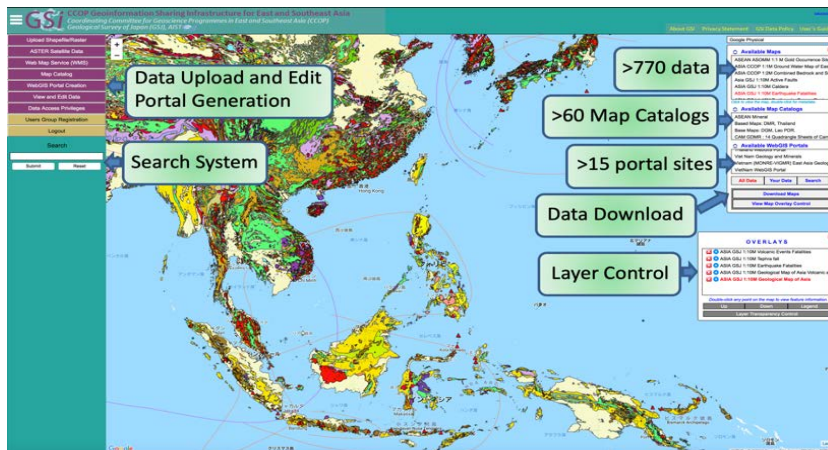
(6) Asia-Pacific Region Global Earthquake and Volcanic Eruption Risk Management (G-EVER)

G-EVER is a consortium among the geohazard research institutes in the Asia-Pacific region (http://g-ever.org). The Asia Pacific Region Earthquake and Volcanic Hazard Information System contains hazard information data, which were used for the publication of the geological hazard map covering East Asia (Takarada et al. 2016). Geological map, active faults, earthquakes hypocenters and source areas, fatalities of major earthquakes, tsunami hazards, distribution of volcanoes, calderas, pyroclastic falls and ignimbrites (large-scale pyroclastic flows) and fatalities of major volcanic events are available on the system. A mobile version of the information system is also developed. The mobile version can be use for important function such as the determination of the   distance between the user's current location and the nearest active fault and displayed on the mobile screen. The system's data about active faults, fatalities of major eathquakes and tsunami hazards were updated on April 2019. On the other hand, the data about caldera, tephra fall and ignimbrite were updated on July 2019.
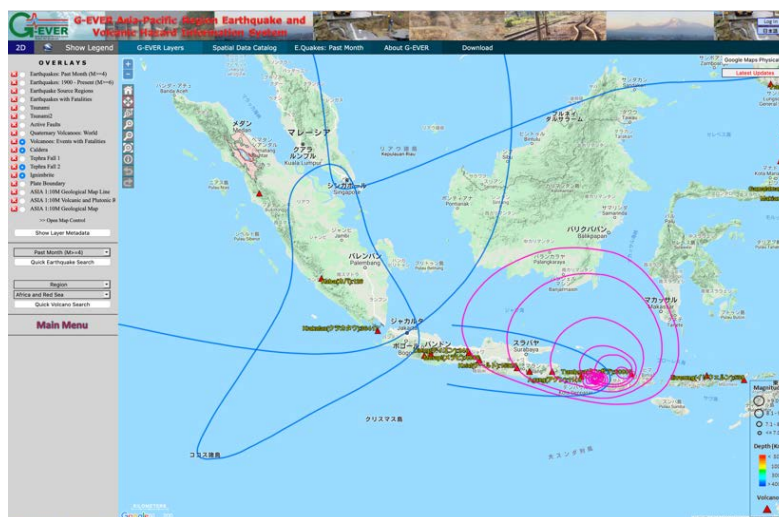
G-EVER Asia-Pacific region earthquake and volcanic hazard information system.
Updated tephra fall and ignimbrite distribution data are displayed.

(7) Integrated Geosciences Data Processing (IGDP) capacity building for ASEAN

states and CCOP member countries.

The 3rd workshop of CCOP-CGS IGDP project phase II (IGDP-II2) workshop was held in Qingdao, China on 18-22 September 2019, hosted by China Geological Survey.   There were 28 participants from Cambodia, China, Indonesia, Japan, Korea, Lao PDR, Malaysia, Mongolia, Myanmar, Papua New Guinea, Philippines, Thailand and Viet Nam attended this workshop and training. Practical use training of RGIS-IGDP software was conducted and geophysical compilation work and techniques were discussed, and a short-term work plan was drafted.

CCOP-IGDP training course was held on 18-22 Oct. 2019 in Qingdao, China

(8) GSJ International Training Course on Practical Geological Survey Techniques – Application to Geological Disaster Mitigation.

GSJ started regular training course for young geological researchers and engineers in the CCOP member countries in 2018. This training course focuses on practical geological survey techniques, considering that accurate geological mapping is fundamental for natural resources development, environmental conservation and mitigation of geological disasters. This training course aimed at improving the trainees' geological survey skills through intensive lectures, field trips and laboratory works.

GSJ's researches on geological disaster mitigation are also introduced in the course. For this year, the course started on June 4 and ended on June 21, 2019.

GSJ International Training Course field trip in Daigo area, northeast Japan.

(9) Digital geological mapping (DGM) training courses in Myanmar and Brazil

A training course on digital field geological mapping on 26-30 Nov. 2018 was invited to conducted in Brazil. There were 15 professionals from geology and mineral, land, data analysis and geo-information divisions attend the training and discussion.

And a 8-day training course on DGM was conducted by CGS on 8-16 Dec. 2018 in Naypyidaw, capital of Myanmar. 75 professionals form geological survey of Myanmar and 4 from mineral exploration companies participated.

(10) Asia Summit geoinformation workshop on natural resource management

A workshop on natural resource management with modern geoscience information technology was held on 10-13 Oct by CGS in Tianjin, China for 48 officials and geological survey professionals from Cambodia, Laos, Myanmar and Malaysia, and other 18 countries from around the world. Geoscience data sharing policy and framework is deeply discussed and a common understanding on future steps were reached.

(11) Geoscience information training courses for developing countries by CGS

CGS conducted a training course on geoscience information technology for developing countries through 15Aug to 13 Sep 2019 in Beijing. More than 20 Participants from Argentina, Ethiopia, Angola, Ghana, Zimbabwe, Morocco and Nigeria are trained with GeoCloud for data integration and sharing, RGIS-IGDP software for geophysical data processing, GeoExpl-international for geochemical data analysis and DGSS for digital field geological mapping both in house and with field practices.

Digital geological mapping training course by CGS

(by Zhang Minghua and Kazuhiro Miyazaki)

7.3.2 CGI in Africa

Several CGI outreach activities were done. Presentations on CGI standards and competition were given at the Organisation of African Geological Surveys technical committee meeting (11-13 June 2019) and the Geoscience Information Consortium (GIC) Africa annual conference (27-29 November 2019) in Windhoek.

In addition to creating awareness of CGI work, in consultation with the Geological Society of Africa, discussions were held in a meeting (online) to revive the Geoscience Information in Africa (GIRAF) and improve engagement with members. A workshop and a meeting is planned for the 28th Colloquium of African Geology (28CAG) in 2020 in Morocco.

(by Kombadayedu Mhopjeni)

7.3.3 CGI in South/Latin America

No report from South America this year due to lack of council at this region.

7.3.4 CGI in North America

(1) 3D Workshop
3D geological mapping workshops have been held approximately every other year in North America since 2001. The 2020 workshop to be held in association with the Geological Society of America conference in Montreal will include emphasis on the current emergence of national digital twin strategies such as Canada-3D and US EarthMAP. Recently, the book "2019 Synopsis of Three-dimensional Geological Mapping and Modelling at Geological Survey Organizations" was published.

(2) American Geophysical Union (AGU)
AGU plays many roles, with the work of the Earth and Space Sciences Informatics (ESSI) Section being one example.

(3) Digital Mapping Techniques (DMT)
DMT is the annual conference for information science professionals who are responsible for digital geological mapping and related geoscience information systems. CGI meetings were held in association with DMT in 2007. The 23rd DMT, held in Butte, Montana, on May 19-22, 2019, was attended by ~100 people. The focus was on the NCGMP09 geologic map database standard, now known as GeMS. The 2020 DMT will be held in May 17-20, 2020, in Rolla, Missouri.

(4) Earth MRI
In 2019, following on a White House Order and a Secretarial Order from the Department of the Interior, which houses the US Geological Survey, the Earth MRI

program, previously known as 3Deep, was launched. Included will be new initiatives in minerals deposit databases.

(5) EarthCube
EarthCube is a US National Science Foundation program designed to transform geoscience research by developing cyberinfrastructure to improve access, sharing, visualization, and analysis of all forms of geosciences data and related resources. EarthCube participants meet regularly. Macrostrat is an example of an EarthCube initiative.

(6) Geologic Mapping Forum (GMF)
Whereas US state and federal geological survey directors and program managers regularly meet to work out geological mapping funding and administration, and geological mapping information science professionals meet at DMT, the GMF has now been established to facilitate coordination between geological map authors and program managers on geological mapping topics. The 1st GMF, in March 2018, was a great success, as was the 2nd meeting in April, 2019. The 3rd annual meeting will be held in Minneapolis on April 7-9, 2020.

(7) Geological Society of America (GSA)
The GSA Geoinformatics and Data Science Division facilitates the GSA role in cyberinfrastructure, through short courses, symposia, books, and awards.

(8) Geospatial Data Act
The Geospatial Data Act of 2018 (GDA) was signed and became law in October, 2018. The law further formalizes the roles of, for example, the Federal Geographic Data Committee (FGDC), and the National Geospatial Advisory Committee (NGAC). Geology is one of the National Geospatial Data Assets (NGDAs) coordinated by the FGDC.

(9) National Cooperative Geologic Mapping Program (NCGMP)
NCGMP consists of geologic mapping by federal (Fedmap), state (Statemap), and university (Edmap) partners. It has long been funded at a level of about $25M per year, which supplements a similar amount spent by other agencies each year.

(10) National Geologic Map Database (NGMDB)
Maintenance of the National Geologic Map Database (NGMDB) is required by law in US. It includes a publications catalog, a 20-year long and ongoing initiative to build information standards, and a planned seamless database known as Phase Three.

(11) National Geologic Mapping Act (NGMA)
The federal NGMA, which authorizes the NCGMP and requires the NGMDB, was re-authorized by Congress this year in US.

(12) US National Geological and Geophysical Data Preservation Program (NGGDPP)

The Energy Policy Act of 2005 authorized the NGGDPP, whose role is to facilitate the preservation and availability of geological samples, logs, maps, and data. The National Digital Catalog describes geoscience collections managed by USGS and state geological agencies. NGGDPP plays an active role in promotion of information standards.

(13) National Geothermal Data System (NDGS)

The NGDS is a catalog of documents and datasets that provide information about geothermal resources located in the US.

(14) US Geoscience Information Network (USGIN)

USGIN is a federated information-sharing arrangement that uses free and open-source technology that is able to interact with similarly configured data-sharing networks.

(by Harvey Thorleifson and Eric Boisvert)

7.3.5 CGI in Europe

In 2019, the two main European initiatives developing pan-european infrastructures with the support of the European Union have been developed. Both of them are implementing and supporting the CGI standards.

• *GeoERA* http://geoera.eu/

45 national and regional Geological Survey Organisations (GSOs) from 32 European countries have joined forces to develop an ERA-NET Co-Fund Action to "Establishing the European Geological Surveys Research Area to deliver a Geological Service for Europe (GeoERA)".

Funding of the projects will partly be covered by the GeoERA consortium members (70%) and partly by European Commission (30%). The programme has a total budget of 30.3 M€, and the projects will run for three years starting in June of 2018. Only members of the GeoERA consortium are beneficiaries of the GeoERA projects.

The main objective of GeoERA is to contribute to the optimal use and management of the subsurface. GeoERA will fund 15 research projects that will aim to support 1) a more integrated and efficient management and 2) more responsible and publicly accepted, exploitation and use of the subsurface. The projects will cover the applied geosciences, addressing the following four themes: geo-energy, groundwater, raw materials, and information platform. The information platform will support the requirement of the 3 other themes, and in particular for data dissemination. It is built on the top of the EGDI (European Geological Data Infrastructure).

GeoERA uses CGI standards for the geological and mineral resources data, and contributes to the evolution of the 3D practices.

• *EPOS* https://www.epos-ip.org/

EPOS, 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.

EPOS brings together Earth scientists, national research infrastructures, ICT (Information & Communication Technology) experts, decision makers, and public to develop new concepts and tools for accurate, durable, and sustainable answers to societal questions concerning geo-hazards and those geodynamic phenomena (including geo-resources) relevant to the environment and human welfare.

EPOS vision is that the integration of the existing national and trans-national research infrastructures will increase access and use of the multidisciplinary data recorded by the solid Earth monitoring networks, acquired in laboratory experiments and/or produced by computational simulations. The establishment of EPOS will foster worldwide interoperability in the Earth sciences and services to a broad community of users.

EPOS mission is to integrate the diverse and advanced European Research Infrastructures for solid Earth science, and build on new e-science opportunities to monitor and understand the dynamic and complex solid-Earth System.

EPOS has been initiated through H2020 co-funded projects, and became a legal body in October 2018. The main H2020 project was finished in September 2019 . The geological data are 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.
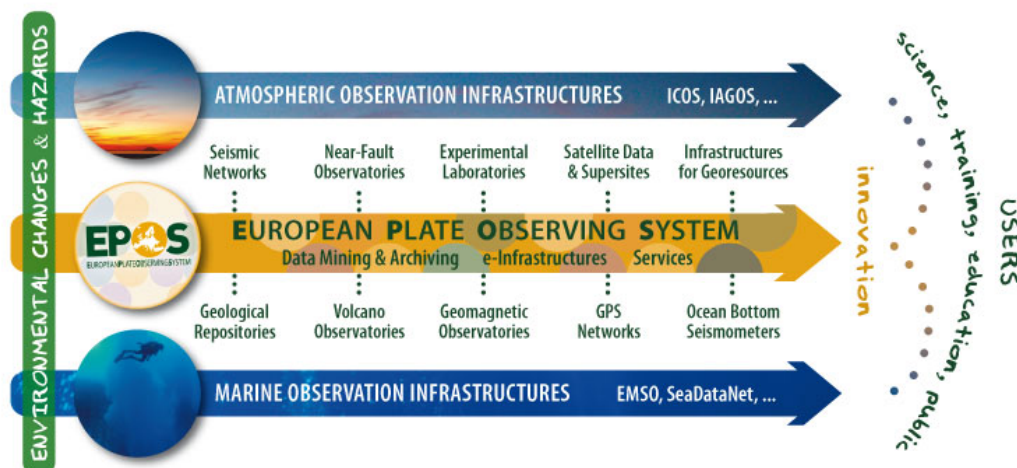
• *5th European Meeting on 3D modelling* http://3dgeology.org/bern.html

The 5th European workshops on 3D geological modelling took place between May 21st – 24th 2019 in Berne – Switzerland.

Discussions addressed the developments of modeling tools and practices, but also focused on the need for standards to access and use 3D models. The concept of digital twins, that

requires this type of standards was also discussed during the event.

(by Francois Robida)

7.2.6 CGI in Oceania

(1) Australia/New Zealand Government Geoscience Information Committee (GGIC)
GGIC continues to coordinate Australasian information management best practice in government geological agencies.   All Australian Commonwealth, States and Territories, and New Zealand, are represented on GGIC.   The Australian geological survey agencies coordinate information management activities in Australia under the banner of the "Australian Geoscience Information Network" (AusGIN).

New Zealand and Australian federal, state, and territory geoscience data
managers at the GGIC meeting in Melbourne, April 2019.

GGIC is the main conduit for promoting and implementing IUGS-CGI work in Australasia. GGIC nominates one of its members to representative Oceania on CGI Council (currently Ollie Raymond from Geoscience Australia).   Ollie will be retiring from CGI Council in 2020 and will be replaced as Oceania councillor by Mark Rattenbury from GNS New Zealand.
Recently commenced GGIC projects include:

- Geochemistry Data Working Group
    o developing a simple data transfer standard, agreed by all GGIC members, for inorganic geochemistry data for solid earth materials (ie, not hydrochemistry,   not organic chemistry)
    o will include vocabularies for sample type, sampling method, material class, which are under development in the IUGS-CGI Geoscience Terminology Working Group

- Petroleum Data Working Group
    o developing stricter national standard guidelines for digital submission of petroleum exploration data to government jurisdictions

o developing agreed data transfer standards for petroleum-related datasets, such as petroleum exploration titles

- Developing a tool for spatial data matching within and between databases
  - o for example, to detect duplicate borehole or sample records in databases, and to match data records from one agency's data to another agency's data.

(2) Australian Resources Data Strategy

The Council of Australian Government (COAG) Energy Council has developed a "Strategic Reform Agenda for Resources", seeking to develop a national strategy to improve the discoverability and utilisation of key geological, biodiversity and heritage datasets. The GGIC will take a leading role in developing and implementing this Resources Data Strategy, which will extend and significantly widen the scope of previous work done by GGIC in coordinating and standardising geoscience data management and access across Australia.

(3) Australian Geoscience Information Network (AusGIN)

AusGIN is the flagship project of GGIC. The AusGIN Portal is GGIC's application for federated delivery of geoscience data using CGI- and OGC-standards based web services.
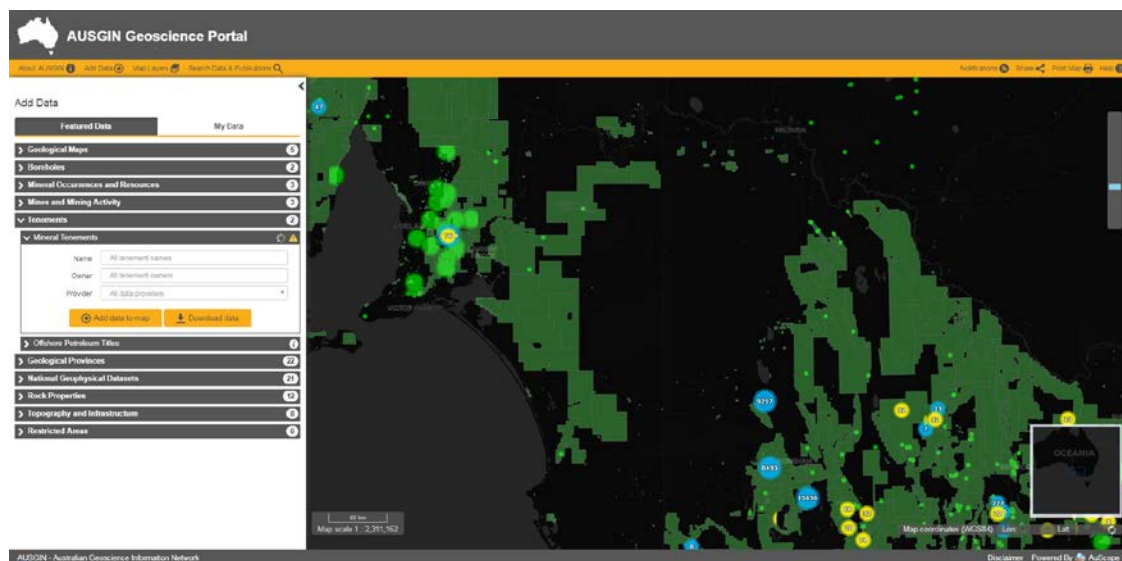

AusGIN Geoscience Portal, showing web map services of mineral exploration tenements, mineral occurrences, and petrophysical measurements as clustered points

New developments in AusGIN include:

- Geoscience Australia providing a technical 'help desk' to all State and Territory Geological Surveys for building web services, training of web service technicians in State/Territory Geological Surveys via teleconference, and mapping of databases to GeoSciML, EarthResourceML and CGI vocabularies.

- building an open-source solution to geophysical data delivery, using NetCDF archive file format and OGC and OpenDap web services – magnetics, radiometrics, gravity,

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and electromagnetics

- improved spatial analysis of Google Analytics data from the AusGIN Portal to analyse user interaction with datasets on the AusGIN Portal. The data provides spatially attributed analysis of where users are displaying, querying, and downloading specific datasets, and how that behaviour changes over time. The results of the analysis can indicate industry interest in particular regions, and can be correlated with promotional events and activities to gauge the effectiveness of government data sharing initiatives.
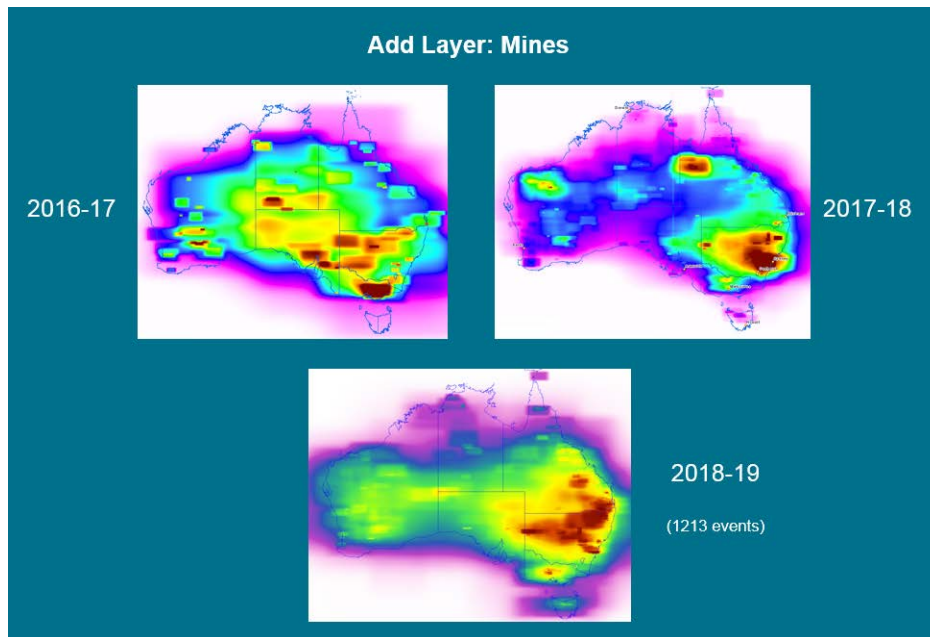
Heat maps of 3 years of user interaction with the Mines data layer in the AusGIN Portal

(4) Cloud

Australasian geoscience agencies are increasingly looking towards internet cloud-based solutions for data management and delivery. Geoscience Australia is recognised as a leading Australian government agency in the use of the "cloud" solutions for data delivery (especially web services) and intends to assist GGIC agencies where it can.

(5) Collaborative Conference on Computational and Data Intensive Science (C3DIS 2019)

The C3DIS 2019 conference was held in Canberra in May 2019. This was the second C3DIS conference, and it is hoped that this will become a regular annual forum for emerging informatics, such as big data driven science, HPC, machine learning, web services, and data visualisation.

(6) E2SIP

A new Australian community of practice called E2SIP is being established

(http://www.c3dis.com/1945).   It is based on the ESIP (Earth Science Information Partners) community in the United States.   Its aim is to "provide a broad community of practice for informaticians in the earth and environmental sciences, with regular face-to-face events in conjunction with the key Australian informatics conferences, together with other forums and technical resources."

(7) Engagement in OneGeology
Australian and New Zealand provide representatives in the OneGeology Technical Implementation Group who advise on technical solutions and best practice for the OneGeology community and OneGeology portal.

(8) Engagement in CGI Working Groups
Australia and New Zealand provide representatives in all CGI standards working groups, including the chair of the Geoscience Terminology Working Group, Mark Rattenbury (NZ). Geoscience Australia's Michael Sexton is planned to take over as chair of the ERML Working Group in March 2020.

(9) New Data Releases
The 2018 version of the national GIS-based seamless 1:250 000 Geological Map of New Zealand includes significant upgrade to the dataset's structure including conformance to GeoSciML Lite standard fields populated with CGI-IUGS vocabulary terms and URIs where required.   The data structure was also used in recently published 1:50 000 geological maps. CGI-IUGS lithology terms have also been applied to the Petlab Geoanalytical database of New Zealand, Antarctic and Southern Ocean rock samples.

A provisional version of the Antarctic GeoMAP dataset, led by GNS Science and including a contribution from Geoscience Australia as well as many other countries, was launched at the International Antarctic Earth Sciences conference in Incheon, South Korea in July 2019. This continent-wide compilation of geological mapping is an aim of a Scientific Committee for Antarctic Research project and has been built with CGI-IUGS vocabulary and GeoSciML data model standards, delivered using ArcGIS Server/OGC web services and available through a portal https://data.gns.cri.nz/ata_geomap/index.html.

GNS Science presented and launched the new Antarctic GeoMAP dataset built to CGI standards at theInternational Antarctic Earth Sciences conference in Incheon, South Korea.

A new version of the Australian Geological Provinces dataset (sedimentary basins, orogens, and cratons as WMS, WFS) has been released and will be offered as a dataset to the OneGeology Portal.
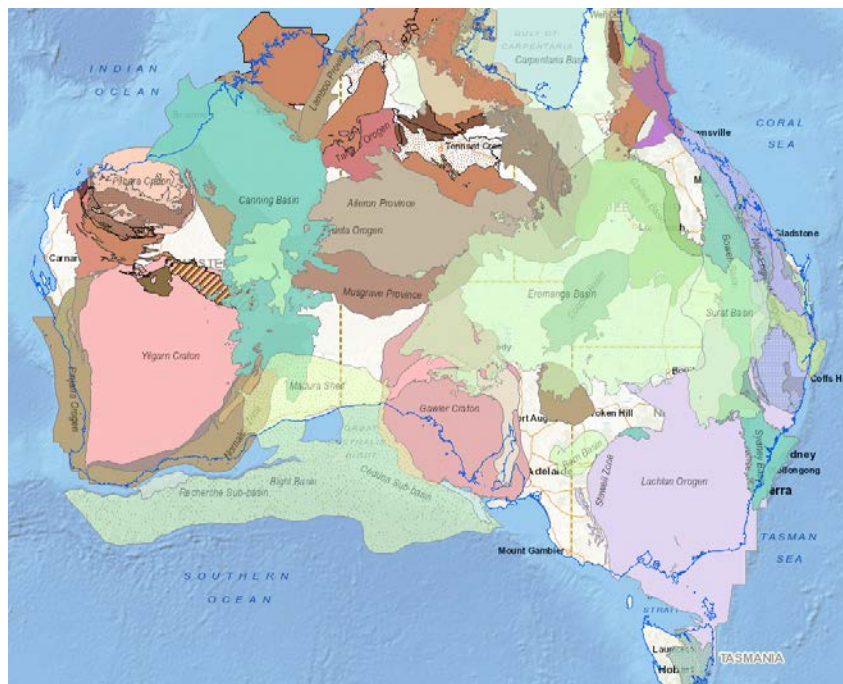
A selection of data from the Australian Geological Provinces web service

A new solid geology dataset and web service from Geoscience Australia, covering the northern half of the Australian continent, is due for release in early 2020.   The dataset will comprise four time-slice layers – pre-Neoproterozoic, Neoproterozoic, Paleozoic, and Mesozoic.   This data will complement the existing 1:1 000 000 scale Surface Geology of Australia dataset

released in 2012.   All the data will be delivered as GeoSciML-Lite compliant web services, and use IUGS and CGI standard terminology for age and lithology.

(by Ollie Raymond and Mark Rattenbury)

8. Main problems encountered

The World's economic and political crisis is having strong impact on monetary support for regional activities of the CGI, in South America and of GIRAF for instances.

The difficulties in cross-border communication and low budget meeting organization make it a challenge to maintain the group cohesion and stay informed on the problems and issues that each of the CGI member countries are struggling with still in 2019.

The CGI Council acknowledges the financial plight of representatives from lesser foundations, and that travel expectations of council members should not be applied as strictly to them. While every effort should be made by all council members to attend annual meetings in person, if this is not possible, then Council members are expected to participate in meetings via teleconference.

Also other outreach activities are often being organized synergistically, based on any opportunities given, rather than merely on medium term planning.

Another difficult issue is to find a common way to open IUGS-CGI accounts not as a private person in order to establish a transparent process of the use of IUGS resources to support CGI activities.

9. Annual Financial Report

Opening balance at 1 Jan 2019:   **AUD 17,438.59** (= EUR 10,773 = USD 12,407)

Two invoices have been paid since the 2018 annual report in November 2018
- BGS web site hosting and web editing contract (March 2018 – March 2019) – AUD 3,670.5
- Madrid meeting room hire - AUD 2,073.44

Closing balance at 10 December 2019: **AUD 17,689.45** (= EUR 10,882 = USD 12,054)

The 2019 annual IUGS grant of USD 2,500 (= AUD 3,416) was received in July 2019. An advance on the 2020 IUGS grant of USD 2,000 (= AUD 2,803) was received in November 2019.

Early in 2019, it was recognised that the current annual IUGS grant was not sufficient to cover the basic costs of the Council (ie, website and meeting room).   A request was made to BGS to consider hosting the CGI website as a free in-kind service to CGI. They agreed via email from Matt Harrison, 2 May 2019.

Upcoming expenses include venue hire for CGI meetings in New Delhi in March 2020 (~AUD 2,000), and payment of the co-sponsored CGI-YES prize for demonstration of CGI geoscience standards (~AUD 2,900).

A detailed bank account statement is attached.

CGI BANK STATEMENT to 10 December 2019 (in AUD)

Date	Description	ST GEORGE BANK			BEYOND BANK			Total Balance (AUD)
		Debit (AUD)	Credit (AUD)	Balance (AUD)	Debit (AUD)	Credit (AUD)	Balance (AUD)	
2016-11-29	Initial deposit from Ollie Raymond to open account					$10.00	$10.00	$10.00
2017-2-1	Interest					$0.01	$10.01	$10.01
2017-2-14	**Initial transfer of CGI bank account funds from previous Credit Lyonnais account**					**$78.42**	**$88.43**	**$88.43**
2017-3-1	Interest					$0.04	$88.47	$88.47
2017-4-1	Interest					$0.08	$88.55	$88.55
2017-4-18	**Final transfer of CGI bank account funds from previous Credit Lyonnais account**					**$31,400.06**	**$31,488.61**	**$31,488.61**
2017-4-18	International transfer fee				$8.00		$31,480.61	$31,480.61
2017-4-18	Australian business registration fee (AUD80) and intitial bank deposit (AUD10) - refund to Ollie Raymond				$90.00		$31,390.61	$31,390.61
2017-4-18	Test deposit to new St George account from Ollie Raymond		$10.00	$10.00			$31,390.61	$31,400.61
2017-4-20	IUGS annual grant		$8,912.66	$8,922.66			$31,390.61	$40,313.27
2017-4-20	Foreign Currency conversion fee	$15.00		$8,907.66			$31,390.61	$40,298.27
2017-4-24	Refund of test deposit to Ollie Raymond	$10.00		$8,897.66			$31,390.61	$40,288.27
2017-4-24	Transfer from old CGI Beyond Bank account			$8,897.66	$5,000.00		$26,390.61	$35,288.27

2017-4-24	Transfer to new CGI St George Bank account		$5,000.00	$13,897.66			$26,390.61	$40,288.27
2017-4-26	Transfer from old CGI Beyond Bank account			$13,897.66	$5,000.00		$21,390.61	$35,288.27
2017-4-26	Transfer to new CGI St George Bank account		$5,000.00	$18,897.66			$21,390.61	$40,288.27
2017-4-27	Transfer from old CGI Beyond Bank account			$18,897.66	$5,000.00		$16,390.61	$35,288.27
2017-4-27	Transfer to new CGI St George Bank account		$5,000.00	$23,897.66			$16,390.61	$40,288.27
2017-4-28	International transfer fee - Council meeting room hire - Imperial Riding School Renaissance Vienna Hotel	$20.00		$23,877.66			$16,390.61	$40,268.27
2017-4-28	International transfer - Council meeting room hire - Imperial Riding School Renaissance Vienna Hotel	$1,204.26		$22,673.40			$16,390.61	$39,064.01
2017-4-28	Transfer to new CGI St George Bank account			$22,673.40	$5,000.00		$11,390.61	$34,064.01
2017-4-28	Transfer from old CGI Beyond Bank account		$5,000.00	$27,673.40			$11,390.61	$39,064.01
2017-5-1	Transfer to new CGI St George Bank account			$27,673.40	$5,000.00		$6,390.61	$34,064.01
2017-5-1	Transfer from old CGI Beyond Bank account		$5,000.00	$32,673.40			$6,390.61	$39,064.01
2017-5-1	Monthly Interest			$32,673.40		$11.19	$6,401.80	$39,075.20
2017-5-2	Transfer to new CGI St George Bank account			$32,673.40	$5,000.00		$1,401.80	$34,075.20
2017-5-2	Transfer from old CGI Beyond Bank account		$5,000.00	$37,673.40			$1,401.80	$39,075.20
2017-5-9	International transfer fee - travel support of Mesfin Gebremichael (GIRAF)	$20.00		$37,653.40			$1,401.80	$39,055.20

Date	Description							
2017-5-9	International transfer - travel support of Mesfin Gebremichael (GIRAF)	$1,722.90		$35,930.50			$1,401.80	$37,332.30
2017-5-9	Transfer to new CGI St George Bank account			$35,930.50	$1,380.00		$21.80	$35,952.30
2017-5-10	Transfer from old CGI Beyond Bank account		$1,380.00	$37,310.50			$21.80	$37,332.30
2017-5-31	Monthly Interest		$3.67	$37,314.17			$21.80	$37,335.97
2017-6-1	Monthly Interest			$37,314.17		$0.02	$21.82	$37,335.99
2017-6-30	Monthly Interest			$37,314.17		$0.02	$21.84	$37,336.01
2017-7-31	Monthly Interest			$37,314.17		$0.51	$22.35	$37,336.52
2017-8-11	Final transfer from CGI Beyond Bank account		$22.35	$37,336.52	$22.35		$0.00	$37,336.52
2017-9-30	Credit Interest		$12.47	$37,348.99	ACCOUNT CLOSED			$37,348.99
2017-10-23	International Transfer Fee	$20.00		$37,328.99				$37,328.99
2017-10-23	International transfer - BGS website maintenance, 2017-18	$3,997.44		$33,331.55				$33,331.55
2017-10-31	Monthly Interest		$3.07	$33,334.62				$33,334.62
2017-11-30	Monthly Interest		$2.73	$33,337.35				$33,337.35
2017-12-20	International Transfer Fee	$10.00		$33,327.35				$33,327.35
2017-12-20	International transfer - BGS vocabulary contract	$8,051.36		$25,275.99				$25,275.99
2017-12-30	Monthly Interest		$2.56	$25,278.55				$25,278.55
2018-1-31	Monthly Interest		$2.14	$25,280.69				$25,280.69
2018-2-28	Monthly Interest		$1.93	$25,282.62				$25,282.62
2018-3-31	Monthly Interest		$2.14	$25,284.76				$25,284.76
2018-4-30	Monthly Interest		$2.07	$25,286.83				$25,286.83
2018-5-31	Monthly Interest		$2.14	$25,288.97				$25,288.97

2018-6-27	IUGS Annual Grant			$3,244.23	$28,533.20	$28,533.20
2018-6-27	International Transfer Fee	$15.00			$28,518.20	$28,518.20
2018-6-29	International Transfer Fee	$10.00			$28,508.20	$28,508.20
2018-6-29	International transfer - BGS vocabulary contract - payment 2	$8,146.52			$20,361.68	$20,361.68
2018-6-30	Monthly Interest			$2.06	$20,363.74	$20,363.74
2018-7-31	Monthly Interest			$1.72	$20,365.46	$20,365.46
2018-8-31	Monthly Interest			$1.72	$20,367.18	$20,367.18
2018-9-29	Monthly Interest			$1.67	$20,368.85	$20,368.85
2018-10-31	Monthly Interest			$1.72	$20,370.57	$20,370.57
2018-11-16	Internet Withdrawal internet fraud	$1,528.00			$18,842.57	$18,842.57
2018-11-16	Internet fraud	$1,507.00			$17,335.57	$17,335.57
2018-11-16	Internet fraud fee	$6.00			$17,329.57	$17,329.57
2018-11-16	Internet Withdrawal internet fraud	$1,407.00			$15,922.57	$15,922.57
2018-11-19	Internet fraud fee recovery			$6.00	$15,928.57	$15,928.57
2018-11-19	Internet fraud recovery			$1,507.00	$17,435.57	$17,435.57
2018-11-30	Monthly Interest			$1.54	$17,437.11	$17,437.11
2018-12-31	Monthly Interest			$1.48	$17,438.59	$17,438.59
2019-1-17	International Transfer Fee	$10.00			$17,428.59	$17,428.59
2019-1-17	International transfer - BGS website hosting	$3,670.50			$13,758.09	$13,758.09
2019-1-31	Monthly Interest			$1.32	$13,759.41	$13,759.41
2019-2-28	Monthly Interest			$1.05	$13,760.46	$13,760.46
2019-3-30	Monthly Interest			$1.16	$13,761.62	$13,761.62

Date	Description	Debit	Credit	Balance		Balance
2019-4-18	International Transfer Fee	$10.00		$13,751.62		$13,751.62
2019-4-18	International transfer - venue hire CGI Meeting Madrid	$2,073.44		$11,678.18		$11,678.18
2019-4-29	Spanish Bank processing fee	$150.42		$11,527.76		$11,527.76
2019-4-30	Monthly Interest		$1.05	$11,528.81		$11,528.81
2019-5-31	Monthly Interest		$0.97	$11,529.78		$11,529.78
2019-6-29	Monthly Interest		$0.94	$11,530.72		$11,530.72
2019-7-3	IUGS Annual Grant		$3,415.77	$14,946.49		$14,946.49
2019-7-3	International Transfer Fee	$15.00		$14,931.49		$14,931.49
2019-7-31	Monthly Interest		$1.24	$14,932.73		$14,932.73
2019-8-31	Monthly Interest		$1.26	$14,933.99		$14,933.99
2019-9-30	Monthly Interest		$1.22	$14,935.21		$14,935.21
2019-10-28	ASIC Australian Business Registration Fee	$36.00		$14,899.21		$14,899.21
2019-10-31	Monthly Interest		$1.10	$14,900.31		$14,900.31
2019-11-18	IUGS Annual Grant		$2,803.48	$17,703.79		$17,703.79
2019-11-18	International Transfer Fee	$15.00		$17,688.79		$17,688.79
2019-11-30	Monthly Interest		$0.66	$17,689.45		$17,689.45
2018-8-28	**BALANCE**					**$17,689.45**

(By Ollie Raymond)

10. Work plan for next year

- Actively participate and to paly important role in IUGS Deep-Time Digital Earth program. And to make effort to play a leading role in DDE Standard Task Group for both solid strong support to DDE and implementation of CGI standards in DDE.

- Organize the Joint symposium of CGI/IAMG/OneGeology/CCOP on *Advances in Global Geological Data Sharing* at the 36th IGC in Delhi, India in early March 2020.

- 3D group of CGI/OGC. Continue to push forward the Joint CGI/OGC Geoscience Domain Working Group work, especially a strategy work plan for CGI within the DWG.

- Continue to push forward the implementation of GeosciML after becoming an OGC Standard.

- Continue the development and implementation promotion of EarthResourceML.

- Continue to push forward promotion of CGI products and to draft a marketing plan.

- Update and enrich the CGI website.

- Take measures to publish the CGI newsletter regularly.

- Take measures to publish more publications of CGI related issues within IUGS "Episodes".

- Represent the IUGS in Geoscience information matters
    - More effective connection with CODATA
    - Enhanced relation with RDA
    - More activities on geoscience information relevant to IUGS involved events towards UN Goals 2030

- Next CGI Council meeting will be held in Delhi, India on 9th March during the 36th IGC 2020. New CGI Councillors will be elected at the meeting, and a new 4-year plan of CGI will be then drafted.

- New councils to complete a draft 4-year future action plan of CGI in his region and working group for a more visible CGI.

11. Critical milestones

- Official creation of CGI/OGC Geoscience Domain Working Group and two sessions of GeoScienceDWG held in 2018 and the draft standard version in 2019 on the OGC/CGI Borehole IE project for GeoScience data description and sharing of Boreholes.

- The setting up of DDE Standard Task Group (STG) under the leading role of CGI for DDE program in 2019. The DDE STG is now consisting of more than 20 geoscientists with 14 CGI member geoscientists and a few CGI councilors, and CGI chair as the group chair. A face to face meeting funded by DDE will be held in January 2020 on the long term workplan and implementation of CGI standards.

12. Budget for 2020 and potential funding sources

CGI Council expects a similar budget to that provided by IUGS in previous years, but a little more would be better for supporting CGI lead DDE standard task group work.

Through the budget form IUGS is not enough for the next year 12 main activities/events, CGI will search for outside support from both Council organizations and in collaboration with regional activities to uphold and realize its annual goal.

Obviously, as the review result from the IUGS ad-hoc review committee that CGI is now at a well-recognized established position in the international geoscience information community and represents IUGS well on geoscience information matters.

13. Objectives and work plan for the next 5 years

A new council of the CGI will be elected in the coming months. It will be formally set up during 36th IGC in Delhi. The current board has updated in 2018 the following workplan for the 5 years from 2019 (this plan will naturally be reviewed by the new Council):

- Actively participate and take responsibility in the IUGS-recognized 'Big Science Program' of Deep-Time Digital Earth (DDE) by playing a leading role in DDE Standard Task Group to provide standards, tools and methodologies to support harmonized Deep Time data in a convenient form to science, public and industry, i.e. to provide insights into the distribution and value of earth's resources and materials, as well as hazards.
- Play a more visible role in coordination of regional initiatives, e.g. by organizing workshop and training courses on geoscience information management, standards and language.
- Continue to push forward GeoScienceDWG in developing interoperability of 3D - 4Dgeosciences data models.
- Catalyze productive alliances between geo-information bodies, including OGC, CODATA, RDA, Linked Data;
- Stimulate progress in development and application of standard geoscience concepts and their representation in multiple languages.

- Promote international use of data exchange standards (especially broad adoption of GeoSciML and EarthResourceML,) 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.
- Prepare a CGI geoscience information symposium at IGC 2020 in India.

14. Suggestions for improvement of IUGS activities

- It would be excellent, if a common way could be found to open CGI accounts not as a private person in order to establish a transparent process of the use of IUGS resources to support CGI activities.

- It would be helpful if IUGS Council can continue to approve CGI's management of annual IUGS allocations to provide the best value for the application of international standards in geoscience data, for a single year's funds from the IUGS is insufficient to do significant work.

  In order to engage contractors to do worthwhile development work, as well as pay for website maintenance and a CGI presence at major conferences (eg, IGC), multiple years of the small amounts of IUGS funding must be saved to create a large enough funds base. For instance, this year CGI spent over USD 11,000 to engage a contractor to insert multi-lingual translations of geological terms into CGI's standard vocabularies. This valuable work was only possible through CGI saving IUGS allocations over several years.

15. Conclusion

As a commission of IUGS for geosciences information, CGI has been very successful in the past 2019 for several big events in geoinformation sciences and milestone achievements in geo-data standards, successful leading the setting up of DDE standard task group, preparation and organization of the joint symposium of CGI/IAMG/OneGeology/CCOP under the theme of IUGS at 36th IGC, local organizations like Asia with several successful regional geoinformation cooperation projects, and a significant big increase of CGI members worldwide, etc.

The ambition of the CGI is clearly to pursue its approach of developing standards for geoscience data, by taking into account current technological developments and the new needs they bring to the future: semantic web and linked data, big data, artificial intelligence, digital twins...

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

- with the ***scientific communities***, in the field of geosciences, with the support of the geological services, by the presence in major international or continental projects (DDE, OneGeology, EPOS, AuScope, …), but 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 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 in the CGI by reinforcing the necessary skills in new technologies.

CGI would like to express its thanks to all members of the CGI and its regional and the working groups, and also to the members of the IUGS Executive for their help and encouragement. We are looking forward very much to a continuous productive cooperation in 2020.

CGI Council, 15 December, 2019.

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