OneGeology newsletter

Providing geoscience data globally

Inside this issue

Introduction

Letter from Kate Royse

Dear OneGeology members and supporters,

Welcome to the 21st OneGeology Newsletter.

2020 has been a very strange year. I was very disappointed that OneGeology members couldn't meet at the IGC in India due to COVID-19; I was so looking forward to meeting up in person. However, that hasn't stopped us from meeting on Zoom with several successful OneGeology Operational Group (OOG) meetings and a very productive OneGeology Strategic Steering Committee (OSSC) meeting just before Christmas, where we had several new faces join us. This enabled us to take a fresh look at what we do and renewed our commitment to OneGeology. Following on from the discussions held at the OSSC, we decided to hold a virtual workshop on digital twins, which took place on 11 February 2021. You will read more about that later in this newsletter.

Last year, we said goodbye to Tim Duffy, who retired as OneGeology project manager, and to François Robida, who retired from BRGM. I thank them for all of their hard work and commitment to OneGeology and wish them well in their retirement and future endeavours.

We were all very sad to hear of the passing of Vic Labson, USGS. He was a great supporter of OneGeology, being involved from very early on, encouraging other organisations to join the consortium. He will be very much missed by OneGeology members and the wider geoscience community.

Finally, I would like to thank Tirza van Daalen and Matt Harrison for their support and to say that I am looking forward to working with you all in 2021.

Prof Kate Royse,
Chief Digital Officer, British Geological Survey; Chair, OneGeology Operational Group.

A note from the OneGeology project manager

I am delighted to be able to contribute to my first annual newsletter as the new OneGeology project manager. I couldn't write this without acknowledging the significant contribution Tim Duffy made to OneGeology during his seven-year term as project manager. During his term, Tim made many contacts and friends across the globe and was instrumental in forging links with other geoscience organisations, some of which became new OneGeology members. Before he left, Tim spent many hours sharing his wisdom with me, for which I am extremely grateful. I know he will be missed by many, but am confident that many OneGeology friends with still see Tim around, particularly as he maintains his position as Chief Scientist for Interoperability Standards on the DDE Standards Group.

Membership of OneGeology is very important to us. Not only does it keep the project going, ensuring its viability, but it also enables us to make new connections and develop collaborations across the geoscience community. We extend a warm welcome to any organisations that are interested in learning more about OneGeology and becoming members.

Last year, I am delighted to say, all current Principal Members signed another five-year consortium agreement. It is disappointing that we were unable to celebrate the signing of this agreement during a face-to-face event at the IGC in Delhi, however we were heartened by the commitment shown by our members. A lot of time and effort goes in to making sure the administrative processes run efficiently. My thanks go to Virginia Hannah, assistant project manager, for taking care of these administrative processes of invoicing, subscription payments and signing of agreements. The smooth running of the administration ensures that OneGeology members and friends continue to enjoy the benefits of being part of this unique digital geoscience community.

Hazel Napier,
OneGeology project manager.

Technical report

Author: James Passmore, BGS GIS specialist and technical lead for OneGeology

As reported in our last newsletter, we are trying to make more of our content open source to allow for easier and better collaboration. We're not quite there yet, but have made some progress. We have reviewed GitHub as a location for our collaboration efforts and have decided it is good enough for our requirements; the OneGeology presence is found at https://github.com/OneGeology.

We've also now almost completed our move to GitHub for the creation of our cookbooks and other technical documentation.

- Create documentation
- View documentation
- Technical discussions

For issues logging and enhancement requests we have moved away from a Redmine-based issue tracker hosted by BRGM called the 'Forge' to https://github.com/OneGeology/TechnicalDiscussion/issues and all Forge issues have now been migrated. If you find an issue when using the portal, catalogue, documentation, web pages or other tools we develop, please feel free to report an issue here.

Agendas and minutes of the Technical Implementation Group are also now found on the TechnicalDiscussion wiki. We are planning to add a frequently asked questions section, to address those questions we frequently have to help with, such 'Do you have any soils data?' or 'Can I have the shapefiles for your data?'. In turn, we will use this content to improve our cookbooks and documentation.

By our next newsletter (and hopefully much sooner than that) we will be able to tell you that we have released the full portal code (front and back-end code) to allow you to build your own portals, or to help us improve ours. The code is likely to be released with a CeCILL licence.

- OneGeology portal statistics for 2020

OneGeology digital twin workshop

We welcomed 44 participants from 21 organisations across the globe to our first digital twin (DT) workshop on 11 February 2021. Participating organisations included:

- AfricaMuseum (Belgium)
- BGS (UK)
- BRGM (France)
- CCOP (East and South-east Asia)
- CGS (Czechia)
- CPRM (Brazil)
- GC (Canada)
- GEUS (Denmark)
- GGSA (Ghana)
- GSI (Ireland)
- GSJ AIST (Japan)
- GSA (Australia)
- GTK (Finland)
- IGME (Spain)
- LNEG (Portugal)
- PGI - NRI (Poland)
- SEGEMAR (Argentina)
- SGU (Sweden)
- TNO (Netherlands)
- USGS (USA)
- VSEGEI (Russia)

The workshop was organised in response to questions posed at the OneGeology Strategic Steering Committee (OSSC) meeting held in November 2020. The aim was to explore OneGeology's long term vision for global geoscience DTs and the unique role it might play in their development.

Following a welcome and introduction from Tirza van Daalen, Chair of the OSSC, and Matt Harrison, we had presentations from:

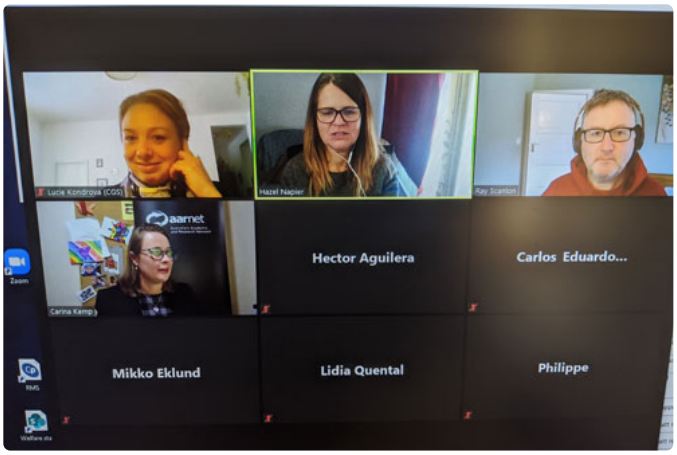
- Michiel Van der Meulen (TNO): Towards digitally twinned river dikes in the Netherlands
- Carina Kemp (AARNET): Trends in digital twins for research across disciplines — what we can learn?
- Guillaume Pepin (ANDRA): From BIM towards 4D digital twin of Cigeo project (French deep geological radwaste disposal) to support operating survey

Participants were then divided into four breakout groups to discuss different aspects of OneGeology's relationship with geoscience DTs. Each group was asked a different question:

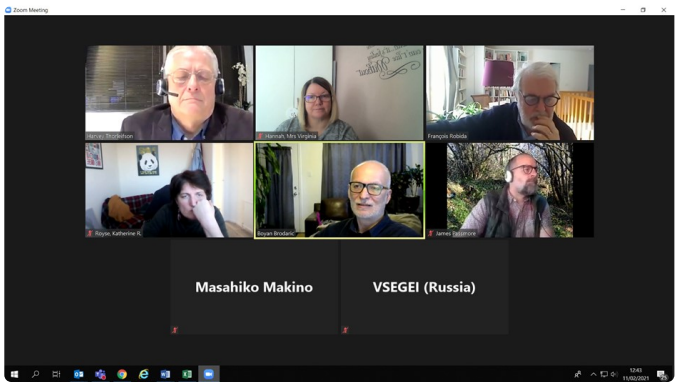
- Group A: what is the risk of OneGeology not becoming involved in DT discussions globally?
- Group B: who should OneGeology be partnering with/talking to about DTs?
- Group C: should the DT discussion be science led, technology led or both?
- Group D: what roles do we need in OneGeology to drive the DT agenda?

An additional, cross-cutting question was posed to all groups: what are the funding challenges/opportunities?

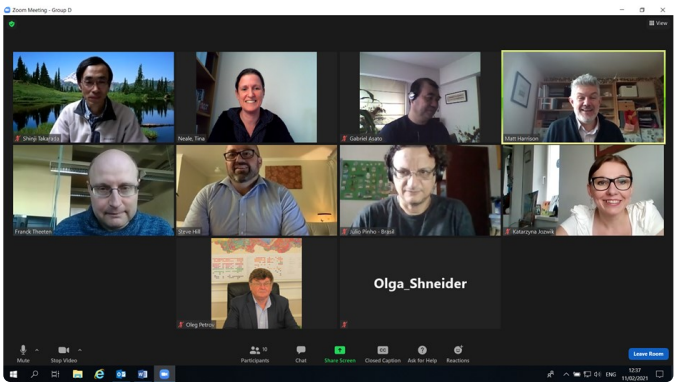
Workshop group A.



Workshop group C.



Workshop group B.



Workshop group D.

There was an agreement that OneGeology had a role to play in ensuring geology and the subsurface is included in future DT developments across a range of sectors requiring collaboration with other initiatives and stakeholders. Whilst OneGeology has a clear role in using standards to promote interoperability and data sharing, alongside technology developments, this should not necessarily be the only focus for OneGeology; DTs should aim to answer societal questions first and foremost, in order to deliver meaningful outcomes and impact for society. Case studies would provide a means to demonstrate the value of geoscience DTs, with technology development providing the means of delivery. Whilst funding of DT development would be challenging, participants felt that now is the time to be included in global discussions with other initiatives such as Deep-time Digital Earth (DDE) EPOS, AuScope, LOOP and Earth Cube, alongside standard setting bodies such as CGI and CGMW and policymakers such as UNGGIM. Any funding sought should be sustainable and not focused on individual project development.

OneGeology is well placed to provide a longer-term strategic view for the next 10+ years and, overall, the meeting saw DTs as a positive and challenging framework for our community to engage between our organisations and potentially in a stronger way with our stakeholders.

As a format, the focused virtual workshop was well received and there are already three mini workshops planned in March 2021 to demonstrate and interact with the Loop3D initiative (see elsewhere in the newsletter). Please contact OneGeology with suggestions for future topics.

Loop: integrated, interoperable, 3D probabilistic geological and geophysical modelling

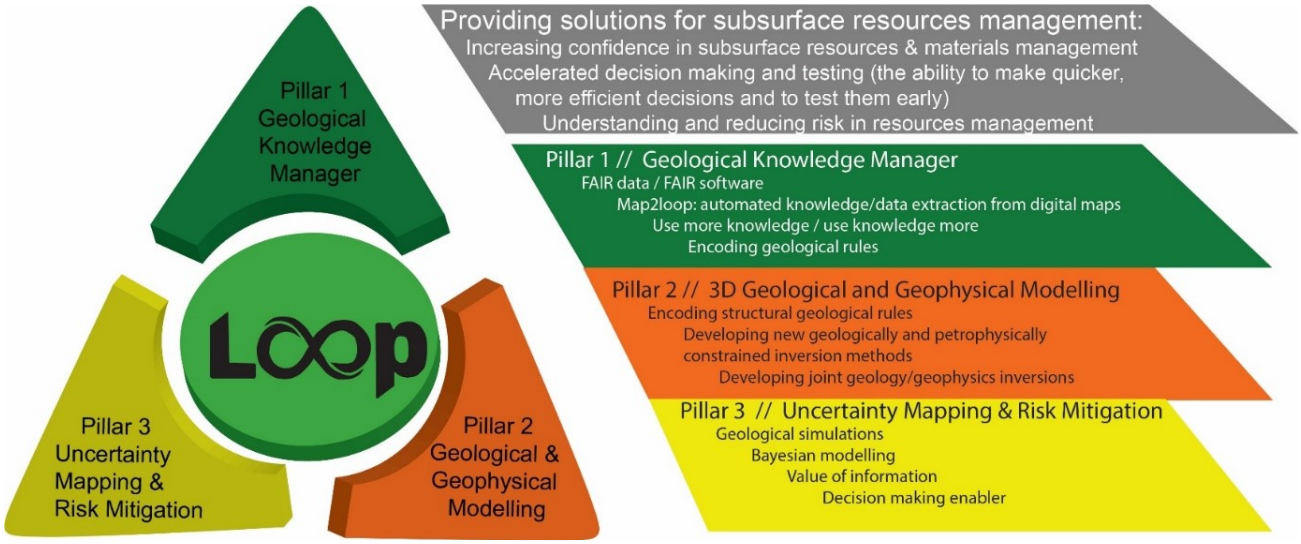
Who are we?

The Loop research program was established in 2018 under the auspices of OneGeology with support from:

- Geoscience Australia (GA)
- the State and Territories Geological Surveys of Australia (GSWA; NTGS; GSSW; GSNSW)
- the Geological Survey of Canada (GSC – Natural Resources of Canada)
- the British Geological Survey (BGS)
- Auscope

The research is led out of Monash University in collaboration with the University of Western Australia, the Research for Integrated Numerical Geology group at Université de Lorraine (Nancy, France) and RWTH Aachen (Germany). GA, BGS and GSC are also research partners.

Since then, we have welcomed new research partners and support organisations with the recent addition of the Université d'Orléans (France), the University of Sydney, Aarnet, the US Geological Survey, ALL of the Australian States and Territories Geological Surveys (GSQ; MRT; GSV) and CSIRO.



The Loop project: a new open-source platform, organised around three research pillars, for rapid and testable decision making based on interoperable, integrated and probabilistic geological modelling.

What is Loop and why?

The rationale for the Loop programme is to support a socially licensed, greener future and sustainable use of Earth's resources through the development of an open-source 3D geological modelling platform that will be interoperable, integrated and based on Bayesian modelling to better understand and manage risk.

One of the biggest challenges of the next decade is to improve our ability to discover new resources and to enhance our resources management via better decision making systems. As a society, we will need to better understand and predict the location and quality of resources to mitigate the risk related to their exploitation. This includes discovery of natural resources such as copper, critical metals and water, but also our ability to better manage our waste storage and plan the development of our cities through the prediction of urban geology and geotechnical properties of the subsurface under our growing communities.

- Interoperable: in addition to dealing with multiple sources of input data and knowledge, the platform will be compatible with a wide range of predictive tools.
- Integrated: all data and knowledge available will be integrated in a series of best-fitting probabilistic 3D models. For example, geophysical datasets will be integrated in the geological modelling phase to reduce the model space rather than at the end of the modelling loop as a simple rejection criterion.
- Probabilistic: we will invert geological data and geophysical data within a Bayesian inversion framework to infer and predict 3D geology.

Where are we at?

Advances in Pillar 1 — augmented data and knowledge

We have developed new methods to extract, organise, manage and use geoscience knowledge for 3D geomodelling. The role of the geological knowledge manager (GKM) is to provide knowledge in conjunction with separately managed observations and measurements. The GKM is based on the recently developed GeoScience Ontology, which is now a comprehensive framework for organizing and expressing any geoscience knowledge using semantic web languages.

In parallel, we have automated the analysis and extraction of knowledge and data from geological maps and some drillhole databases (map2loop). The output provides modelling constraints for the modelling engine. The workflow produces both traditional inputs, such as the orientation and position of stratigraphic contacts, and some limited second-order information such as stratigraphical thickness and fault displacement.

Advances in Pillar 2 — geological and geophysical modelling engines

Recent research in 3D modelling techniques has allowed for better integration of geological observations and knowledge into the geological modelling tools. These improved 3D modelling tools can incorporate more geological knowledge and observations, e.g. fold overprinting relationships, fault-slip vectors and fault displacements.

As a proof-of-concept, we have automated the building of 3D geological models from geological survey-served data, including automatic geological map topological analysis and geological history building. In very specific areas of Australian geology, users can now draw a polygon on a map and generate 3D models in just a few minutes using the map2loop and LoopStructural libraries.

For more information (and references to awesome papers):

- Email Laurent Ailleres@monash.edu
- Loop website
- Loop oin gitHub

CPRM's new OneGeology infrastructure is now microservice-oriented

Authors: Carlos Eduardo Miranda Mota, PhD geologist and head of Data Science Research Group, Department of Institutional Information of Geological Survey of Brazil (CPRM)
Hiran Silva Dias, head of Geoprocessing Division, Department of Institutional Information of Geological Survey of Brazil (CPRM)

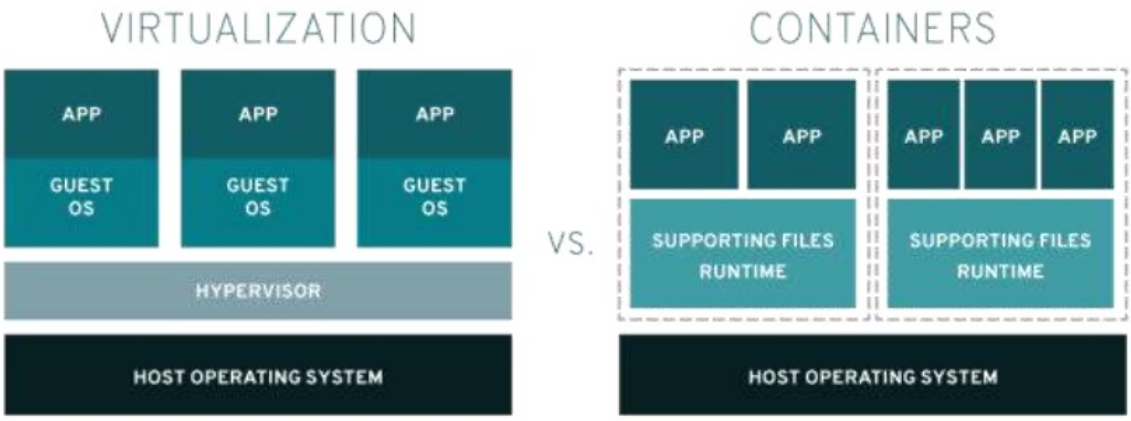
Recently, the Geological Survey of Brazil (CPRM) made a reformulation in the IT environment for provisioning OGC geoservices to OneGeology. This new

system changed current architecture. Now it is mainly taking place on virtual machines (VMs) and monolithic services, to a pool of distributed services, based on microservicesaArchitecture.

At the beginning of the 2000s, the concept of service-oriented architecture (SOA), a popular design paradigm for building software, was established. Basically, SOA is a software architecture pattern that allows us to construct large-scale enterprise applications that generally require multiple services over different platforms, and languages through a common communication mechanism.

Microservice architecture is considered a variant of SOA and an alternative pattern that overcomes the drawbacks of a monolithic architecture. In this architecture, the focus is on modulating the application by dividing it into smaller, standalone services that can be built, deployed, scaled and even maintained independently of other existing services or the application itself as a whole.

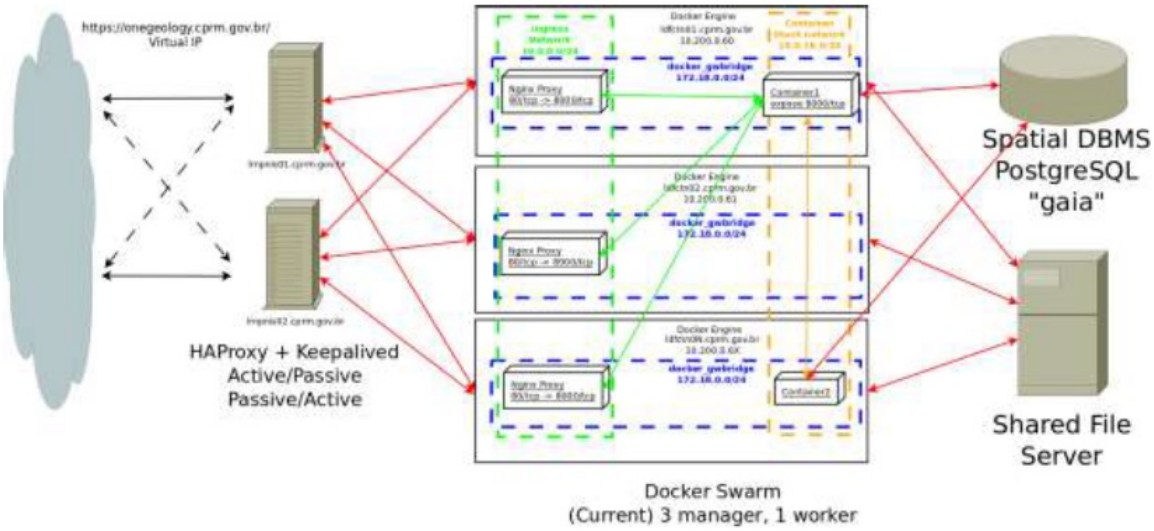
Beside the evolution of software architectural patterns, we have also seen an emergence of adoption of new technologies for supporting OneGeology's software infrastructures and ensuring efficient management of scalable services. Unlike VMs, which are operating system specific, containers are application specific, making them far lighter. Furthermore, VMs can run multiple processes whereas a container runs as a single process, which is more efficient.



A simple diagram showing the difference between virtualisation and containers (reference).

The CPRM's OneGeology map service has been changed from hardware virtualisation to containerisation. To achieve these objectives, at the end of 2020, a brand new microservice infrastructure was deployed in CPRM's headquarters in Brasília, based on the world's leading software containerisation platform, Docker.

The infrastructure comprises a VM cluster composed of a layer with two nodes with embedded HAProxy and Keepalived. This was set up for proxying requests, with load balancing and high availability. These requests go to the Compute layer, which initially has four nodes of Docker Engine Server, in Swarm mode. The nodes have eight processor cores and 8 GB of RAM, with the possibility of expansion. The persistent data nodes comprises an Institutional PostgreSQL/PostGIS Database (Gaia) and a shared file server (NFS).



Overview of microservice architecture deployed on CPRM's data centre in Brasília.

All software used in CPRM's legacy servers was containerised and updated

- 1-GeoServer from 2.7.2 (Tomcat 7, Java 8) to 2.17.4 (Tomcat 9, OpenJDK 11)
- Spatial DBMS PostgreSQL 8.4 to 12 and PostGIS 1.5 to 2.5

Furthermore, an exclusive OGC CSW server (Geonetwork 3.10) was added to the stack to host the CPRM's OneGeology metadata catalogues.

Finally, all legacy content was replicated to the new environment and the existing databases were checked for geometric consistency to repair invalid geometries and improve the performance. The next step will be to update the capable services to GeoSciML version 4.1.

The access to CPRM's Map Services will now be through a single endpoint, available at the OneGeology portal.

CCOP Geoinformation Sharing Infrastructure (GSi) for East and South-east Asia

The Geological Survey of Japan (GSJ), AIST has been implementing the CCOP Geoinformation Sharing Infrastructure (GSi) for East and South-east Asia project, in cooperation with the geological institutes in East Asia, since 2016. More than 820 geological maps and related information are made available on the GSi system (Figure 1). There are also more than 20 portal sites from CCOP countries that were set up using the GSi system.

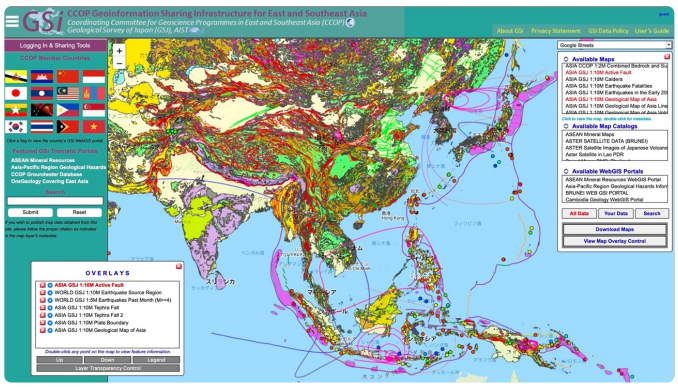


Figure 1 Main page of the CCOP Geoinformation Sharing Infrastructure for East and South-east Asia (GSi) system.

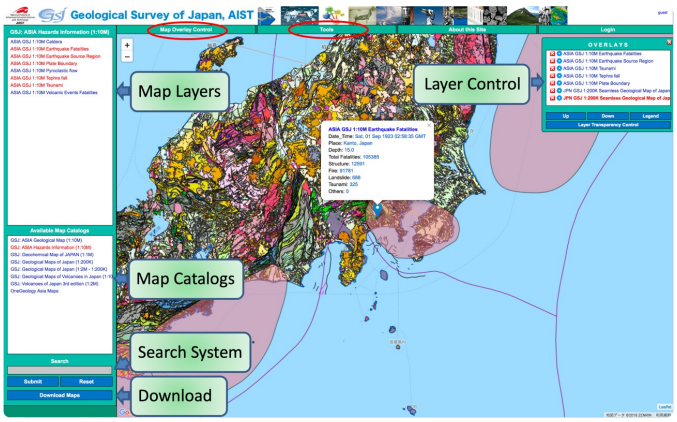


Figure 2 The GSi-generated portal site of the Geological Survey of Japan, AIST. The 200k seamless Geological Map of Japan, earthquake source region, tephra fall distribution and plate boundaries are shown.

The fifth international workshop of the CCOP GSi project (Online) was held on 8 December 2020 (Figure 2). Twenty-five scientists attended the activity, from:

- Brunei Darussalam
- Cambodia
- Indonesia
- Japan
- Republic of Korea
- Laos PDR
- Malaysia
- Mongolia
- Myanmar
- Papua New Guinea
- Philippines
- Thailand
- Vietnam

Each country representative gave a presentation about the progress of the data uploaded and shared on the information system. Discussions about the future activities for the next phase of the project (phase II, 2021–2026) were also made (Figure 3).

There are presently more than 120 GSi-registered geological maps and related contents that are also registered on the OneGeology portal. These maps include:

- 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
- 1:10K to 1:50K geological maps in volcanic areas in Japan (Figure 4)

We plan to register more GSi maps on the OneGeology portal within the year. Any comments and suggestions on the CCOP GSi project are appreciated.

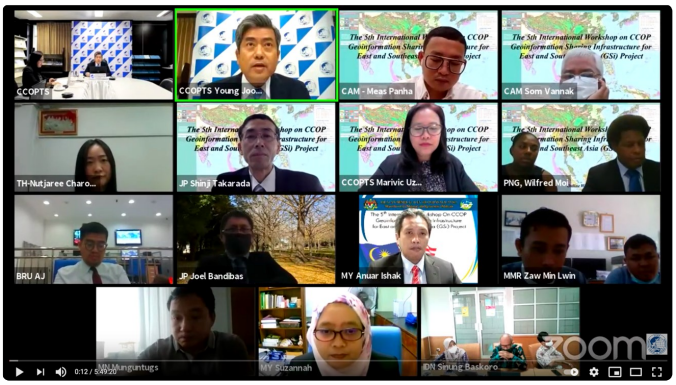


Figure 3 The Fifth International Workshop on CCOP GSi Project on 8 December 2020 (Zoom online).

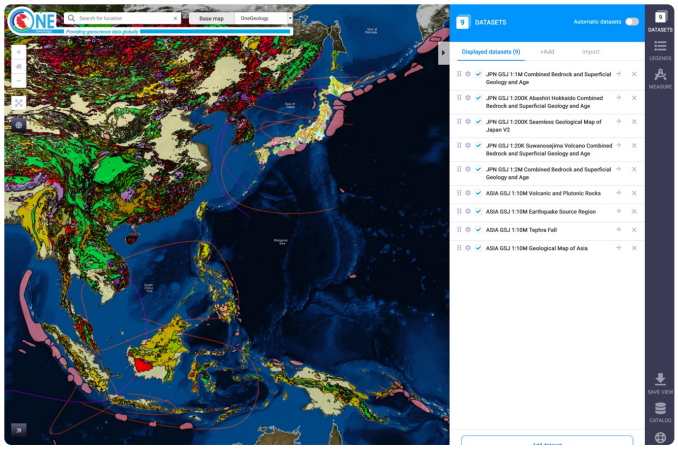
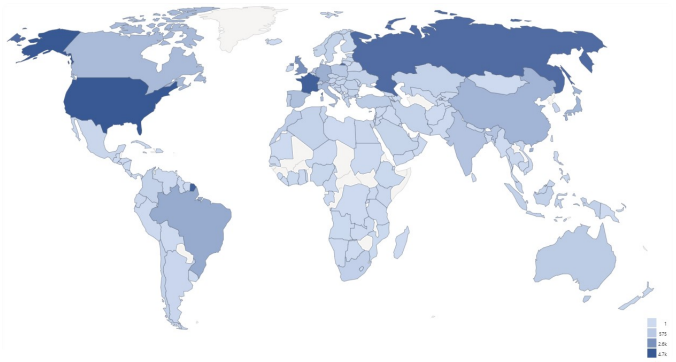


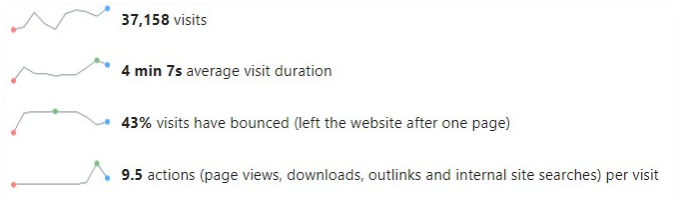
Figure 4 Asian geological maps and related contents, which are registered on the OneGeology portal.

OneGeology portal

The year 2020 is now behind us and it is time to take look at the OneGeology portal activity. Throughout the year we collect information about our visitors to figure out how to meet their needs and usage. Here is some of the key information we want to share with you.

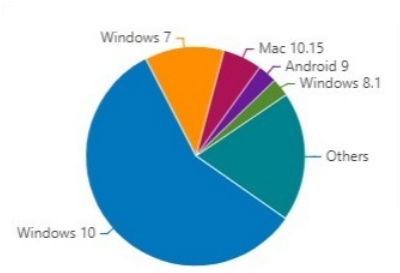


Visits overview map.

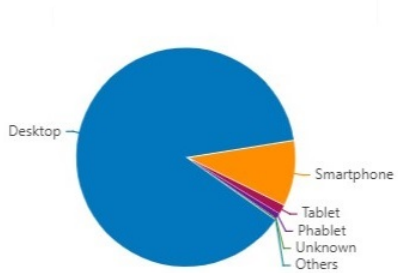


Visits overview.

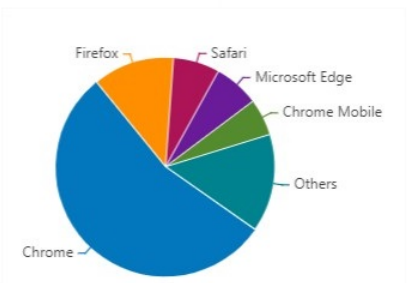
We are proud to see that the portal is used all over the world by more than 37 000 unique visitors in the year with an average visit duration of five minutes by executing about ten actions.



Operating system



Device type



Browser

Here we can see tools, software and hardware used by our visitors. This allows us to focus on testing on these platforms to ensure an optimal experience.

Finally, we pay attention to the most consulted data on the portal. This gives us a good indicator of what information users wants to see.

We collect this information, but we are aware that we can be even more precise about what we observe in order to better understand the behaviour of our users. Work will be done this year to improve the process.

World CGMW 1:50M Geological Units Onshore	31,750
CIS VSEGEI 1:1M Geology	23,017
AFR CGMW-BRGM 1:10M Geological units	20,945
Europe GISEurope 1:1.5M Bedrock Age	18,307
CIS VSEGEI 1:200K Geology	15,663
Eurasia CGMW 1:12,500,000 Geological Units	13,856
BRA CPRM 1:1M Bedrock	8,650
EASIA CCOP 1:2M Combined Bedrock and Superficial Geo...	8,394
Andes BRGM 1:2M Detailed Geology	7,658

Useful links

OneGeology website: http://www.onegeology.org
OneGeology portal: http://portal.onegeology.org
OneGeology Brighton Accord: http://www.onegeology.org/what_is/accord.html
Consortium agreement: http://www.onegeology.org/docs/OneGeology-Consortium-Agreement-2019-Final.pdf
OneGeology help: onegeologyhelp@bgs.ac.uk General questions: onegeology@bgs.ac.uk
Twitter: @OneGeology | #onegeology

OneGeology administration

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Providing geoscience data globally

Newsletter February 2021 compiled and edited by Virginia Hannah and Lina Hannaford