



Fossil Hill and the Island panorama in the Cliefden Caves area.

National and International Geoheritage - Cliefden Caves, Fossil Hill and Trilobite Hill, New South Wales, Australia at risk of being flooded by construction of a dam.

M Brocx - Department of Environmental Science; Murdoch University, Western Australia, Email: geoherit-age@inet.net.au; **I Percival** - Co-Convenor for Geological Heritage, NSW Division of the Geological Society of Australia; **V Semeniuk** - VCSR, Western Australia; **R A L Osborne** - Co-Convenor for Geological Heritage, NSW Division of the Geological Society of Australia

Here we make a case that there is a need for an International Convention for the Conservation of sites of Geoheritage significance.

An area in central New South Wales (Australia) is being threatened by the proposed construction of dam at the Needles Gorge on the Belubula River (Figures 1, 2 & front page). The area is renowned for its Internationally significant Ordovician fossils at Fossil Hill and Trilobite Hill, for the Nationally significant Cliefden Caves, and for a warm-water spring and tufa dams of State significance. The area also has historical significance as the

site where limestone was first discovered in inland Australia.

With over 100 recorded caves, the cave system has been ranked as one of the most significant limestone cave sites in Australia with impressive speleothems (Figures 3, 4 & 5). The Taplow Maze Cave, for instance, has a network of passages over 3 km long, contains rare blue stalactites, and has unusual mineral and sediment deposits that are an important record of past environments.

Ordovician rocks in the vicinity of Cliefden Caves belong to the Cliefden Caves Limestone Group and the Malongulli Formation. These rocks contain some of the most scientifically valuable (in some cases unique) fossils in Australia, with several examples of global significance. Fossil Hill and Trilobite Hill have long been recognized as iconic examples of Australia's palaeontological heritage. At least 62 scientific papers have been published, documenting 191 genera and 263 species of fossils from these and other sites in the vicinity of Cliefden Caves. Of these, 45 genera and 101 species are unique to the area that is threatened by flooding. Specimens from this area documented in the geological literature include the world's oldest known in situ brachiopod shell beds (Figure 6), the earliest rugose corals found anywhere on Earth, and one of the most

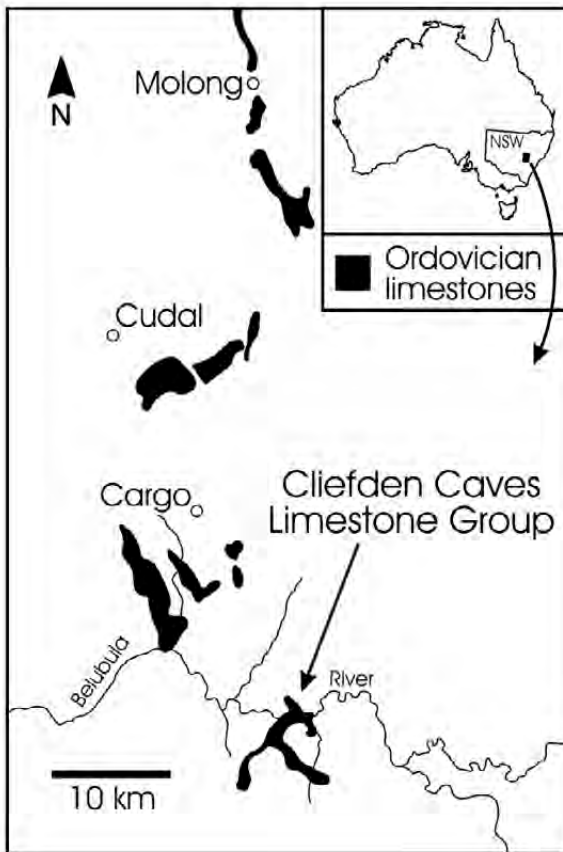


Figure 1: Occurrence of Ordovician limestones in central western New South Wales and the location of the Cliefden Caves Limestone Group and the Belubula River (from Webby & Packham 1982).



Figure 2: More detailed map of the Cliefden Caves area showing location of Fossil Hill, Trilobite Hill, Dunhill Bluff, and the Belubula River, outcrop of the three limestone formations of the Cliefden Caves Limestone Group, and the occurrence of the Malongulli Formation, the tufa, and the warm-water spring (map simplified from Webby & Packham 1982).

diverse deep-water sponge faunas ever recorded, living on an oceanic slope environment that is very rarely preserved in the geological record. The limestones also contain an ichnofauna.

Many type specimens were first described from Fossil Hill, the adjacent Dunhill Bluff, or from Trilobite Hill. These type localities are in danger of inundation beneath the lake resulting from the construction of the proposed dam. Several of these fossil species, such as the trimerellid brachiopod *Belubula spectacula* occur nowhere else in the world (the genus is only recognized in two places – Fossil Hill, and south China – which in itself provides critical evidence of plate tectonic movement when these areas in the Ordovician Period were situated considerably more closely than today).

The construction of a dam at the Needles Gap will completely flood Fossil Hill and most of the caves, destroying their heritage value and preventing future study. Alternative dam sites suggested at nearby Cranky Rock will also detrimentally impact the Cliefden Caves area.

The tufa in the Cliefden Caves area is a constructional landform developed within a tufa-depositing Davys Creek. Geomorphological and sedimentological evidence in the fossil tufas and alluvial terraces have been used to construct the fluvial history of Davys Creek. After an initial sustained aggradation, there was rapid incision between 1500 and 1600 years BP in response to a shift to a moister climate, succeeded by a second major aggradation event 1500 years BP to 150 years BP, then subsequent incision following the arrival of Europeans at 150 years BP.

That the dam is being considered at Needles Gap is an example of competing values and a lack of informed decision making (i.e., economic imperatives versus scientific, educational, and intrinsic values), and a lack of a legislative and/or policy framework that recognises the “value” of irreplaceable non-renewable natural assets that will be lost to future generations of the Australian and International community if the proposed



Figure 3: Complex of speleothems from a cave in the Cliefden Caves area (photo Garry K Smith).

dam proceeds. Further, the land that is being affected by the proposed construction of the dam is under private ownership, and the landowner has no say to prevent the inundation of the Geoheritage values of the area that their family has protected for several generations.

The potential inundation of Cliefden Caves and Fossil Hill is only one example of sites of Geoheritage significance, and particularly fossil localities that are under threat of destruction globally.

We make the case that there is a demonstrated need for the establishment of an international Treaty or Convention for the protection of sites of Geoheritage significance, i.e., an International Convention for the Conservation of sites of Geoheritage significance, similar in principle to the International Conventions currently in place for the protection of biodiversity, e.g., the Convention on Biological Diversity (CBD).

Selected bibliography

- Australian Heritage Council. 2012. Australia's Fossil Heritage: a catalogue of important Australian fossil Sites. Collingwood: CSIRO Publishing.
- Brocx, M. 2013. Geoheritage values at Fossil Hill, central western New South Wales. The Australian Geologist Newsletter Number 168, September 2013, pages 14-15. <http://www.gsa.org.au/pdfdocuments/publications/TAG%27s/TAG%20168%20WEB.pdf>



Figure 4: Complex helictites from the Cliefden Caves area (photo Thomas Wilson).



Figure 5: Blue stalactite from the Cliefden Caves area (photo Garry K Smith).

- Carthew, K.D. & Drysdale, R.N. 2003. Late Holocene fluvial change in a tufa depositing stream: Davys Creek, New South Wales, Australia. *Australian Geographer* 34(1): 123–139.
- Davey, A.G. 1984. Evaluation criteria for the cave and karst heritage of Australia-Report of the Australian Speleological Federation National Heritage Assessment Study. *Helictite* 15(2): 3-40
- Osborne, R.A.L. 1978. Structure, sediments and speleogenesis at Cliefden Caves, New South Wales. *Helictite* 16(2): 3-32.
- Percival, I.G. 1995. Eodinobolus and related trimerellid brachiopods from the Late Ordovician of New South Wales. *Memoirs of the Association of Australasian Palaeontologists* 18: 41-60.
- Rigby, J.K. & Webby, B.D. 1988. Late Ordovician sponges from the Malongulli Formation of central New South Wales, Australia. *Palaeontographica Americana* 56: 1-147.
- Webby, B.D. 1969. Ordovician stromatoporoids from New South Wales. *Palaeontology* 12: 637-662.
- Webby, B.D. 1969. The new Ordovician genus *Hilophyllum* and the early history of rugose corals with acanthine septa. *Lethaia* 4: 153-168.
- Webby, B.D. & Semeniuk, V. 1971. The Ordovician coral genus *Tetradium* Dana from New South Wales. *Journal and Proceedings of the Linnaean Society of New South Wales* 95: 246-259.
- Webby, B.D. & Packham, G.H. 1982. Stratigraphy and regional setting of the Cliefden Caves Limestone Group (Late Ordovician), central-western New South Wales. *Journal of the Geological Society of Australia* 29(3/4): p297-317.
- Webby, B.D. & Percival, I.G. 1983. Ordovician trimerellacean brachiopod shell beds. *Lethaia* 16: 215-232.
- Zhen, Y-Y & Webby, B.D. 1995. Upper Ordovician conodonts from the Cliefden Caves Limestone Group, central New South Wales, Australia. *Courier Forschungsinstitut Senckenberg* 182: 265–305.



Figure 6: Shell bank of in situ *Belubulaia* in Ordovician limestone at Cliefden Caves.

A strong public campaign against the Needles Gap dam proposal is underway, with an on-line petition gathering signatures from across the world. You are welcome to add your voice by signing this petition at:

www.savecliefdencaves.org.au/petition

The Geological Society of Australia, through its national and state-based Geoheritage coordinators, has also joined in by writing submissions to government authorities involved in preliminary feasibility studies into water storage options in the region.



Part of the the team promoting geoconservation initiatives at the 6th WPC. From left to right: Roger Crofts, Margaret Brocx, Enrique Díaz-Martínez, Kyung Sik Woo, John Gordon, unknown visitor, Vic Semeniuk and Kyong-o Moon.

Geoconservation steps into the 6th World Parks Congress in Sydney

Enrique Díaz-Martínez (e.diaz@igme.es), John Gordon (jgordon0914@gmail.com) and Margaret Brocx (m.brocx@iinet.net.au)

As announced in a previous issue of ProGEO News (see vol. 2013, no. 3, p. 5), a Geoheritage Specialist Group (GSG) was officially formed last year within the World Commission on Protected Areas (WCPA) of the International Union for the Conservation of Nature (IUCN). See the web page here:

http://www.iucn.org/about/work/programmes/gpap_home/gpap_biodiversity/gpap_wcpabiodiv/gpap_geoheritage/

We (Enrique Díaz-Martínez and John Gordon) have been actively contributing to this group as ProGEO members since its inception. For the record, the first meeting towards its constitution was held on Monday September 12th, 2012, during the 5th World Conservation Congress (Díaz-Martínez, 2012), although the formal recognition from IUCN only came in 2013 after the Terms of Reference of the GSG were officially approved.

The elected chair of the GSG is Kyung Sik Woo, a professor of geology at the University of Kangwon (Korea),

and several ProGEO members are actively involved: Enrique Díaz-Martínez (Spain) and John Gordon (United Kingdom) are deputy chairs, and Margaret Brocx (Australia) has also recently joined the group. One of the objectives of the GSG has been to incorporate geoconservation principles and actions into the IUCN, as a means to facilitate and influence geoconservation at national and regional scale.

IUCN members, whether governments or NGOs, must abide by IUCN's resolutions. That is why, in 2012, we worked hard and managed to get Resolution 5.048 passed by the IUCN General Assembly and available at <https://portals.iucn.org/library/node/44015>.

One of the mandates of this resolution calls on IUCN members to ensure that, when reference is made to nature in general, preference is given to inclusive terms like nature, natural diversity or natural heritage, so that geodiversity and geoheritage are not excluded. Another mandate in the same resolution calls on the WCPA to promote and support proper management of geoheritage in protected areas.

It is within this latter mandate that we successfully worked towards geoheritage being included into the program of the IUCN 6th World Parks Congress (WPC), held in Sydney, Australia 12-19 November 2014. This congress is a decadal event organized by the WCPA. If we had missed this opportunity, we would have had to

wait 10 years for the next one! The good news is that, in a highly competitive selection process, we succeeded in being allocated a session in the only science-based theme, Reaching Conservation Goals. In addition we were also successful in securing two (well attended) side sessions (see below).

The WPC involved a lot of hard work, but it really was a joint effort from many people. Each individual contribution, whether large or small, made up the sum of the whole. Here is the resulting program of geoc onservation-related events that took place at the WPC (downloadable from <http://www.igme.es/patrimonio/wpcin.htm>):

Thursday November 13th:

- Set up of geoheritage stand for display
- Parallel event on “ Local solutions to environmental challenges” at the Nature-Based Solutions Pavilion. The event was facilitated by Margaret Brocx, and included the participation of John Gordon, Roger Crofts, Enrique Diaz-Martinez, and Vic Semeniuk.

Friday November 14th:

- Parallel event on “The importance of geoheritage conservation in protected areas and help available” at the Protected Planet Pavilion. The event was facilitated by Kyung Sik Woo, and included the participation of Roger Crofts, Tim Badman, Nigel Dudley, John Gordon, Vic Semeniuk, Enrique Díaz-Martínez, Patrick McKeever, and Graeme Worboys.
- Presentation of an e-poster on Stream 8 (New Generation, Capacity Development) by Enrique Díaz-Martínez, on “ Innovating in communication to different types of public in parks: geoheritage interpretation is

possible!” The e-poster was available on screens for browsing during the congress, and will be available until May 2015 at <http://wpc2014.digitalposter.com.au/>, where you can browse for other topics and authors. Afterwards it will still be available at <http://www.igme.es/patrimonio/wpcin.htm>.

- WCPA Europe members meeting, convened by Andrej Sovinc, the WCPA Regional Chair for Europe. More details on the meeting are here: http://cms-data.iucn.org/downloads/2_iucn_wcpa_europe_members_meet_at_wpc.pdf
- Green List of Protected Areas (PAs): awards given to the managers of PAs in recognition of their work towards nature conservation. Though it was not explicitly acknowledged as such, many of the awarded PAs incorporate geoheritage and practical geoconservation.

Monday November 17th:

Fieldtrip to Blue Mountains National Park and World Heritage Site, organized by Margaret Brocx and Vic Semeniuk for the IUCN WCPA Geoheritage Specialist Group, with the support of Ian Percival and Armstrong Osborne from the New South Wales Division of the Geological Society of Australia, Felicity Trend (VCSR), and Anne Poelina (Nyikina Traditional Owner, specialist on cultural heritage).

The Blue Mountains World Heritage Site, originally declared by UNESCO based on its biodiversity, is also an area of geoheritage significance. The excursion provided an excellent case study of the links between geology, geomorphology, geodiversity, habitats, and biodiversity.



Enrique Díaz-Martínez presenting ProGEO activities at the side event of November 13th.

Tuesday November 18th:

Full session on geoconservation issues organized within Stream 1 (Reaching Conservation Goals), one of the main streams and themes of the WPC. The session was titled "Using geodiversity for reaching conservation goals" and facilitated by Enrique Díaz-Martínez (ProGEO, IGME, SGE). The programme consisted of the following:

- 15 min presentation by V. Semeniuk and M. Brocx: Increasing species conservation and diversity, and better management of coastal wetlands and freshwater ecosystems.
- 15 min presentation by E. Díaz-Martínez: Use of geodiversity index maps improves conservation in different types of protected areas: case examples from the Pyrenees.
- 30 min round table and discussion led by V. Semeniuk and M. Brocx: Stemming the loss of biodiversity using a multidisciplinary approach: filling the gap between theory, policy and practice,
- 30 min panel discussion facilitated by Roger Crofts on "The challenges and opportunities of using a geoheritage approach to reaching conservation goals", and with brief participations of Kyung Sik Woo, Margaret Brocx, Vic Semeniuk, John Gordon, Armstrong Osborne, Enrique Díaz-Martínez, and many contributions from the audience.

The preparation, submission and arrangements made for the inclusion of this thematic session within Stream 1 of the WPC began in late 2013 and were not easy. Margaret Brocx, Vic Semeniuk and Kevin Page made important contributions to the original application to IUCN, leading finally to the proposal being incorporated into Stream 1. We were not aware of how this session was received in comparison with other WPC sessions, but one of the attendees, and the theme session rapporteur, both provided feedback that it had been the best session that they had attended at the WPC. This was welcome feedback!

Geoheritage stand: Throughout the whole congress, we had a modular stand in the main WPC showground, with an exhibition on geoconservation initiatives: pamphlets, books, posters, etc. It was an excellent opportunity to showcase our work, chat with all those interested, and to promote ProGEO's latest book (*Geoconservation in Europe*) and the journal *Geoheritage*. Several posters by John Gordon & Roger Crofts, and Vic Semeniuk & Margaret Brocx, also highlighted the important links between geodiversity and biodiversity.

A total of AUD \$6,000 was contributed for the cost of the geoheritage stand, as well as drafting and printing of posters and free books sponsored by the Australian Wetlands Research Association.



View of the audience participating in the side event of November 14th during John Gordon's contribution.



Intervention of Roger Crofts at the Stream 1 plenary on November 18th, asking to mention geodiversity and geoconservation in the final conclusions of the stream.



Audience participating in the side event of November 13th.



Margaret Brocx on the geoh heritage stand

Financial and in-kind support for the stand came from ProGEO, the Geological Survey of Spain (IGME), the Australian Wetlands Research Association, the V & C Semeniuk Research Group (VCSRG), the Geological Society of Australia, the Australasian Palaeontological Society, and the IUCN Geoh heritage Specialist Group. This was certainly a joint collaborative effort that set the stage for a successful output at the WPC.

Based on our record of attendance, and on feedback from participants, the geoh heritage stand was a big success. Some 70 people visited the stand on the first day, and there were over 250 visitors overall. We could not have achieved this level of exposure without the stand or without the support of all the aforementioned contributors. The stand had one or two persons attending to visitors and curious passersby all day long during each of the five congress days from the 13th to the 18th of November. Attending the stand were Margaret Brocx and her two adult sons Kieran and Jean-Luc (both of them warmly thanked for volunteering), Vic Semeniuk, Enrique Díaz-Martínez and John Gordon, as well as other colleagues from the GSG.

There were multiple requests for copies of the posters and for further information. We actually ran out of flyers, books, pamphlets and journal issues, indicating the high level of interest on the subject. Many visitors expressed appreciation for the opportunity to discuss matters related to geoh heritage, geodiversity and geoconservation, and the possibility to exchange information and resolve questions.

The target audience for all the events and for the stand was WPC attendees. Most of them are not Earth scientists or geoh heritage specialists, but instead most frequently they were park agents, managers and senior staff, and most of them with backgrounds in biology, ecology, forestry, planning, geography, education, etc.



Participants in the GSG fieldtrip to the Blue Mountains National Park and World Heritage Site on November 17th.



Panel discussion during Stream 1 session on November 18th. From left to right: Roger Crofts, John Gordon, Kyung Sik Woo, Armstrong Osborne, Margaret Brocx, Vic Semeniuk and Enrique Díaz-Martínez

More good news is that the new version of the WCPA Protected Area Governance and Management manual will be published online in February 2015, and for the first time it will contain a substantial chapter on geoh heritage. An accompanying article appeared in the IUCN journal *Parks*, in time for the congress (Crofts and Gordon, 2014).

In sum, we hope to have contributed to the recognition of geoh heritage within IUCN as a category of natural heritage, and for it to be more formally included in protected area management globally, towards both IUCN and ProGEO's geoconservation objectives.

References:

- Crofts, R. and Gordon, J.E. 2014. Geoh heritage conservation in protected areas. *Parks*, vol. 20, no. 2, p. 61-76. <<http://parksjournal.com/parks-20-2/>>
- Díaz-Martínez, E. 2012. The world's leading nature conservation organization incorporates geoconservation in its agenda. *ProGEO News* 2012, no. 3, p.4 -6. <http://www.progeo.se/news/2012/pgn312.pdf>

Coming events:



- **EGU 2015, Vienna, April 12-17, 2015**

Geoheritage, Geodiversity and Cultural Landscapes: key issues for present and future times

Convened by Paola Coratza, Hanneke van den Ancker, Sjoerd Kluiving, Emmanuel Reynard, Grazina Skridlaite

<http://meetingorganizer.copernicus.org/EGU2015/session/17788>

Heritage is a complex concept, culturally constructed and under discussion, and arbitrarily divided into natural and cultural components even if this distinction is often not beneficial for its conservation and management (e.g. World Heritage). The artificiality of this division clearly shows in the concepts of geological and cultural landscape. The first, Geological Landscape, primarily focuses on the physical aspects of a territory, such as the landforms and natural processes; the second, Cultural Landscape, is defined by the variety of cultural elements caused by short- or long term anthropogenic activities.

We observe and admire many landscapes that have been altered by humans – the so-called “cultural landscapes” – which in fact represent relationships between physical and anthropogenic components that interacted. In this session, we would like to address this important theme, currently subject to debate in many national and international scientific worlds. E.g. how to link geological environments, components, phenomena and processes and their variety with people, landscape and culture in a multidisciplinary approach? How to value the combination of natural and cultural perceptions of landscapes with respect to implementation of geoheritage at different scales? What is the contribution of cultural landscape elements to geodiversity?

We invite in particular papers and posters related to the following themes:

- relationships between geodiversity, the physical environment and cultural elements;
- links between geoheritage and cultural heritage (including intangible heritage);
- links between geo-cultural landscapes and biodiversity, re-naturalization;
- geoheritage and geodiversity assessment, education, promotion (geotourism) and networking.

The UN Assembly declared 2015 the International Year of the Soil, for which reason contributions on soil heritage, soil diversity and relationships with cultural heritage issues are particularly welcome.

The deadline for submitting abstracts is January 7, 2015 (13:00 CET) on:
http://www.egu2015.eu/abstract_management/how_to_submit_an_abstract.html

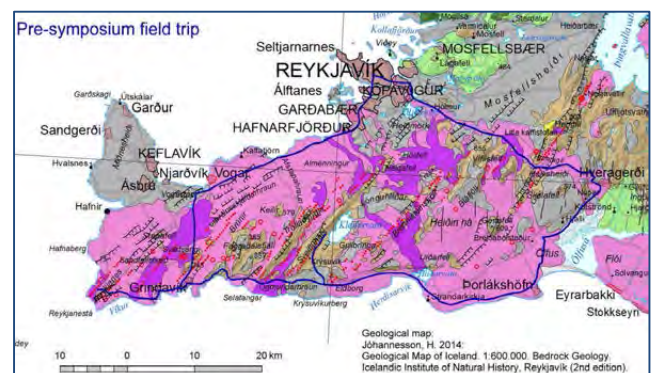
- **XI Reunión Nacional. Comisión de Patrimonio Geológico/SGE Geoparkea – Zumaia**

The national Spanish meeting of CPG/SGE is held in Zumaia 9–13 June 2015. See www.progeo.se for more information

- **The VIII International Symposium of ProGEO in Reykjavík, Iceland 2015.**

GEOCONSERVATION STRATEGIES IN A CHANGING WORLD

The Symposium will take place September 8–12, 2015. The meeting will host a ProGEO General Assembly. Sessions will be held 9-10th whereas excursions will be arranged 8. and 11-12. September in spectacular and geological landscapes. See www.progeo.se and last issue of ProGEO NEWS for more information.



- **Geological Heritage Inventories: Achievements, challenges and perspectives**

European Congress 2015. The aim of this conference is to review the various regional, national and international actions that have been undertaken so as to understand how European public policies approach geological heritage. 23–26 September 2015, Muséum de Toulouse, France.

See www.progeo.se for more information

GeoTreat – geology in your pocket

Erika Ingvald, SGU - email: Erika.Ingvald@sgu.se

Some four years ago, the director generals of the Geological Surveys of Sweden, Finland, Denmark and Norway, decided to make a joint effort to bring the charms and fascination for geology to the public – through a mobile app named GeoTreat.

The whole idea was based on the growing interest in geotourism worldwide, in the need for new efficient channels for raising the awareness of, and interest in, geology among the public coupled to the similar geology between the four countries and a common market for tourism.

With GeoTreat offering an infrastructure for presenting geological information directly to the visitor, the need for putting up signs in nature, keeping the information up to date and the actual sign fresh and clean decreases. And where there is a lack of human guides explaining the geology in a place, the app can at least give an introduction.

GeoTreat was launched by GEUS, GTK, NGU and SGU at the International Geological Congress in Brisbane, Australia in August 2012. The result being that Australia also joined GeoTreat. We've also arranged a workshop in Uppsala (May 2013) inviting colleagues from all over Europe to spread interest for GeoTreat.

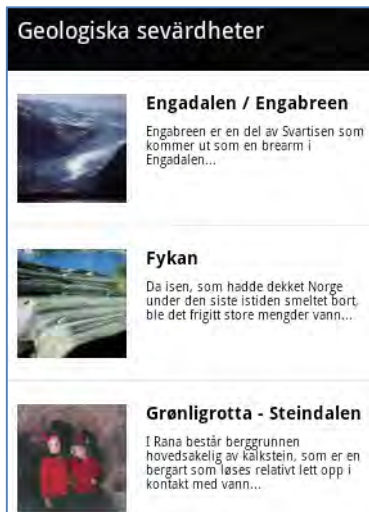
Each country is responsible for publishing and updating their localities of choice. The locality is shown on a Google map in your smart phone. When clicking the locality a card opens with a photo, a short popular description of the geology of the site and if available, links to other sources of information, such as websites, youtube movies or pdf-files.

All in all almost 400 sites are represented in GeoTreat, and the number is growing. In Sweden, we have for example included localities from areas where we've made geotourist maps. We have also added sites when we've done public awareness campaigns in different parts of the country. One example is on the island of Gotland during the summer of 2013, in connection to a groundwater mapping project with TEM technique. We're presently discussing new themes and areas to include.

So far GeoTreat has only been available for an android phones but currently we're working on an html5 version, which means this app will be platform independent.

More information on how to download GeoTreat and another SGU app, GeoKartan:

<http://www.sgu.se/produkter/kartor/mobilappar/>



Deadline next issue of ProGEO NEWS: April 4th. 2014

Please do not forget to send contributions to ProGEO NEWS. Members are interested in things that happen all over the world, your experiences, geosites, everyday geotopes and landscapes, geoconservation and geotourism efforts! ProGEO news is published on the internet

www.progeo.se

Please send your contributions 500 – 2000 words with photographs, maps and figures clearly marked as a ProGEO NEWS contribution to:

lars.erikstad@nina.no

If longer texts are needed, please contact the editor

ProGEO: European Association for the Conservation of the Geological Heritage. • **Address:** Box 670, SGU, SE-751 28 Uppsala, Sweden. • **Treasurer:** Sven Lundqvist. • **Bank:** SWEDBANK, SE-105 34 Stockholm, Sweden. Swiftcode: SWEDSESS. **IBAN:** SE91 8000 0838 1613 7672 5782. • **Membership subscription:** personal: € 50 (including GEOHERITAGE subscription), 25/yr.(without journal subscription), institutional: €185/yr. • **President:** José B. R. Brilha, Earth Sciences Department, University of Minho, Campus de Gualtar, 4710-057 Braga, PORTUGAL. • **Executive Secretary:** Lars Erikstad, NINA, Gaustadaleen 21, NO-0349 Oslo, Norway. **ProGEO NEWS** - A ProGEO newsletter issued 4 times a year with information about ProGEO and its activities. Editor: Lars Erikstad, NINA, Gaustadaleen 21, NO-0349 Oslo, Norway, Phone: + 47 91 66 11 22, Fax: +47 73 80 14 01, e-mail: lars.erikstad@nina.no. Contributions preferred by mail (Unformatted Word- or ASCII-format).

ProGEO NEWS produced with support from the Norwegian directorate for Nature Management