Review

A Fifteen Year Geological Journey with the IUCN Natural World Heritage Sites: Geoscience Education and the Conservation of Nature

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A Fifteen Year Geological Journey with the IUCN Natural World Heritage Sites: Geoscience Education and the Conservation of Nature

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Abstract: As an International Union for Conservation of Nature (IUCN) voluntary reviewer of the natural World Heritage sites nominations focusing on criteria (vii) superlative natural phenomena and (viii) geological history I had the opportunity of evaluating 13 nominations from 12 countries from 2009 - 2022 from the Central Highlands of Sri Lanka to the Vatnajokull National Park Iceland. An early appreciation of the natural history and landscapes were developed as a geologist studying, working and visiting various areas in the USA and Canada. Further experience, as an academic in Sri Lanka and Australia, where I also had the opportunity of various assignments and meetings that afforded field trips and study tours to many World Heritage sites in Asia, Africa, South America and Europe. In this paper, I highlight the following sites that were subject to IUCN World Heritage evaluations and their potential for geo-education: Central Highlands Sri Lanka, China Danxia, Ningaloo Australia, Trang An Vietnam, Lut Desert Iran, Barberton South Africa, Trondek Klondike Canada, Vatnajokull Iceland, Classic Karst Slovenia, Sof Omar Ethiopia, Ha Long Bay – Cat Ba Archipelago, Vietnam and Evaporitic Karst Caves of Northern Apennines, Italy. From these experiences it is apparent that this relevant topic, the conservation of nature, should be an important part of the geoscience's study curriculum along with other social and environmental subjects.

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Introduction

As a geologist an early appreciation of the natural history and landscapes were developed from 1956 – 1967 studying (Keweenawan Copper Country, Michigan), working (Rocky Mountains BC), researching (Mount Tremblant Park Quebec), and visiting various areas in the USA (Lake Superior) and Canada (Niagara Falls). Further geological experience was had on a Canadian Government assignment in Sri Lanka from 1967 – 1970 to help establish the first University Department of Geology, working with the Smithsonian Elephant Research projects in Yala and Wilpattu Parks and starting up research in the Central Highlands and Sigiriya.

During an academic career at the University of New South Wales, Sydney Australia from 1971 – 2010 visits to the Blue Mountains and Uluru – Kata Tjuta were undertaken as well as overseas tours to many World Heritage sites in North America the Morne National Park, Newfoundland, Dinosaur National Park, Alberta and Yellowstone, Grand Canyon and Yosemite in the USA as well as the Hawaii Volcanoes; in Asia Mount Taishin, China, the Sunderbans in Bangladesh and Ha Long Bay in Vietnam; in Africa Dombashowa and Victoria Falls in Zimbabwe and the dunes in Namibia; in South America, Machu Pichu in Peru, Galapagos in Ecuador and the Salar in Bolivia and in Europe the Alps, Þingvellir, Iceland and Cappadocia in Turkey. As a founding member and Councillor of the Association of Geoscientists for International Development from 1976 – 1984 allowed trips to many sites, such as the East African Rift and Masai Mara in Kenya.

The Selection of Desk Top Reviewers

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Voluntary experts are mainly drawn from members of International Union for Conservation of Nature (IUCN) Commissions, in particular the World Commission on Protected Areas (WCPA), and other and scientific networks, such as the International Association of Geomorphologists (IAG) and the International Union of Geological Sciences (IUGS). These experts must be able to comment on one or several nominated sites based on personal working experience at the site or with specific thematic or regional issues relevant to the nomination. Experts having a role in the nomination process on behalf of the nominating State Party are not eligible to serve as reviewers. With my background and in response to an IUGS call for experts I volunteered to undertake desktop reviews for nomination sites with globally significant geological and physiographical features (criteria vii and viii) as part of the IUCN evaluation process.

(vii) containing superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance and especially

(viii) to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features was of most interest

IUCN

Under the World Heritage Convention, the IUCN is the technical advisory body to the World Heritage Committee on natural heritage. Independent and confidential desktop reviews are an indispensable component of the evaluation process. It allows IUCN to provide a sound and balanced evaluation of nominations by tapping on the wealth of technical and site-specific knowledge through the various networks. These experts must be able to comment on one or several nominated sites based on relevant scientific (inter-)disciplinary backgrounds, World Heritage expertise, personal working experience at the site or with specific thematic or regional issues relevant to the nomination. Although IUCN criteria vii and viii are the focus other IUCN biological (ix – x) criteria may be involved as well as ICCROM (the International Centre for the Study of the Preservation and Restoration of Cultural Property) and ICOMOS (the International Council on Monuments and Sites) (i – vi) in the nominations as follows:

i. to represent a masterpiece of human creative genius.

ii. to exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design.

iii. to bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living, or which has disappeared.

iv. to be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history.

v. to be an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change.

vi. to be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria);

ix. to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.

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x. to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

Review Process

The purpose of this desk review is to assist IUCN's work to make global assessment of the degree to which the nomination makes a strong or weak claim for Outstanding Universal Value (OUV), which is seen as a highly selective approach to global significance, as defined in the World Heritage Convention's Operational Guidelines (Croft et al 2021, McKeever and Narbonne 2021).

The process also considers the reviewers knowledge of the site, competence and prior involvement. Reviewers are requested to not simply repeat information already included in the nomination document in their review, but rather to complement the nomination with their own global knowledge. References to published papers that support the points made in the review are highly useful and should be included at the end of the review.

Each of the following seven questions require comment on each criterion included in the nomination.

1. What do you regard as the strongest claims for outstanding global significance made in this nomination (please note that the very restricted nature of the World Heritage list means that these values must be of the highest global significance?)
2. What weaknesses, if any, do you see in the claims made for outstanding universal value?
3. How would you rate the quality of the global comparative analysis in the nomination? Is it rigorous? Is it convincing? What do you see as its strengths and weaknesses?
4. Are any natural criteria (ix and x) that were not proposed of possible relevance to this nomination?
5. From your knowledge are there other areas containing similar natural values at the national, regional and global level, that are either of equivalent or greater conservation significance than the nominated site. Please provide details, and explain the comparisons you would make with those areas?
6. Does the nominated property meet the conditions of integrity and, if not, what is necessary for the conditions to be met? Are, for example, the design of boundaries and buffer zones adequate?
7. Does the nominated property have adequate long-term legislative, regulatory, institutional and/or traditional protection in place to ensure that the outstanding universal value and the conditions of integrity are maintained?

Conclusions, additional comments and references are also required in the review. There is no direct questions or guidelines on the geoscience educational and field experience merits of the nominations and this paper attempts to show their importance.

Geoscience Education and World Heritage Sites

Many World Heritage sites have spectacular geoscience education and field description attributes. The World Heritage List are described in detail and open to specialists and the public alike (https://whc.unesco.org/en/list/). The list of World Heritage sites in most countries in the world have cultural, natural and mixed properties and the natural ones under criteria vii and viii should be part of a special geoscience education subject and a virtual if not real geological field trip. This is especially relevant in countries where these sites are located. The geology and landforms described are very worthy of study especially at the undergraduate university level as a contribution to the understanding of the geoheritage of the country, region and world. For example, the Barberton

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Makhonjwa Mountains of South Africa which was reviewed (6) in this paper can be easily accessed through the World Heritage website list with detailed description, maps, documents, gallery and indicators. Mention should also be made of the UNESCO Geopark Program (https://www.unesco.org/en/iggp?hub=67817) which is also an excellent source of sites of geoscience education significance (Martínez-Martín et al. 2023). Education through all means is an essential key to geoconservation awareness (Tormey 2022).

Geoheritage Education Categories for reviews (after Crofts et al 2021)

1. Key stages in Earth history
2. Major structural and tectonic features
3. Types, occurrence and formation of minerals
4. Rare rock types and rock structures
5. Evolution of life
6. Contemporary Earth processes
7. Representative surface and subsurface features
8. Records of past environmental conditions

Reviews

From 2009 – 2022 I had the opportunity of reviewing 14 nominations from 12 countries. These sites are considered significant for geoscience - heritage education, regardless of them being listed or recommended for inscription or not. My comments are general, personal and not confidential or conclusive. Each site has been placed in appropriate main geoscience and geoheritage categories that display their unique importance for study and research.

1. Central Highlands Sri Lanka (Category 4)
2. China Danxia (Category 7)
3. Ningaloo Australia (Category 1)
4. Trang An Vietnam (Category 7)
5. Lut Desert Iran (Category 6 and7)
6. Barberton South Africa (Category 1, 4 and 5)
7. Trondek Klondike Canada (Not categorised but an excellent example of a historical gold rush and interaction with Indigenous People)
8. Vatnajokull Iceland (Category 1, 6 and 7)
9. Classic Karst Slovenia (Category 7)
10. Sof Omar Ethiopia (Category 2 and 7)
11. Badian Jaran Desert China (Category 6 and 7)
12. Ha Long – Cat Ba Archipelago Vietnam (Category 7)
13. Mt. Gumgang DPRK (Category 1 and 7)
14. Evaporitic Karst Caves of Northern Apennines, Italy (Category 3 and 7)

1. Central Highlands of Sri Lanka (Rajapaske 2017)

Reviewed in 2009 and 2011 and inscribed in 2010 (criteria ix, x)

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Invited to report on the nomination in 2009 and familiar with the site as a Canadian Colombo Plan expert in the Department of Geology, University of Ceylon from 1967 – 1970 which was a joint Canada – UNESCO project. Nomination mainly based on its biological uniqueness of global significance (criteria ix and x) but as I can personally attest it is also a classic site for the study of the lower crustal high grade metamorphic rocks and complex structural development. I note that these attributes (criteria vii and viii) where not considered in the submission.

2. China Danxia (Peng 2020)

Reviewed in 2009 and inscribed in 2010 (criteria vii, viii)

Represent a unique type example of red bed sandstone geomorphology and although the landform areas are in separate provinces, they constitute a continuous belt displaying different stages in their development. Experience in the Blue Mountains near Sydney Australia which is a similar world heritage site of an uplifted and eroded sandstone plateau, so I was able to better understand the Danxia site.

3. Ningaloo Coast Australia (Claudino-Sales and Claudino-Sales 2019)

Reviewed in 2010 and inscribed in 2011 (criteria vii and x)

The site has unique reef and karst system biodiversity along an arid coastline with a continuous Cenozoic record section that dates to the breakup of Gondwanaland. Familiarity with another world heritage site at Shark Bay just to the south contributed to my review.

4. Trang An Viet Nam (Mai and Quan 2020)

Reviewed in 2016 and inscribed in 2014 / 2016 (criteria v, vii, viii)

A unique karst – cave landscape with the development and separation of the terrain from the sea to on land with detailed geological and geomorphological descriptions. Like the World Heritage Halong Bay karst site however it is on land and better access to visitors. Visited Halong Bay as a tourist in 2010 and was impressed by the karst features in the sea.

5. Lut Desert Iran (Maghsoudi et al.2019)

Reviewed in 2015 and inscribed in 2016 (criteria vii, viii)

The site represents the development and evolution of the desert landscapes which includes the highest yardangs and unique nebkhas in the western part and very high sand sea dunes in the eastern part. Familiar with the desert landforms of Central Australia but they are not equivalent. I have subsequently visited the dunes in Namibia in 2017, so I now have a more personal appreciation of the landscape.

6.Barberton Makhonjwa Mountains South Africa (Shabalala and Simatele 2019)

Reviewed in 2017 and inscribed in 2018 (criteria viii)

It is the only nominated Precambrian geological world heritage site. It has the oldest, 3600 – 3200 million years, well preserved Archaean greenstone sequence of rocks and provides accessible sites for scientific research, geo - tourism and information on the earliest life forms, crustal formation, impact events and the type locality of komatites. This greenstone belt is the site for mining and the Sheba Mines is one of the oldest still working gold mines in the world. Worked in the Mattagami greenstone belt in Quebec Canada so familiar with the geology and mineral deposits.

7. Trondek Klondike Canada (Trondek Klondike World Heritage Site Nomination 2021)

Reviewed in 2017 and withdrawn 2018 (criteria iv, vi)

A living historical and frontier cultural landscape that reflects the enduring coexistence of the First Nation Indigenous tribe with the iconic 19th century Klondike gold rush people located in and around Dawson City, Yukon. Both the Indigenous people and the gold rush settlers established a frontier culture, and this compares with past Australian gold rushes.

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8. Vatnajokull National Park Iceland (Petursson and Kristofersson 2021)

Reviewed in 2018 and inscribed in 2019 (criteria viii)

Diversity of pristine, real time, evolving glaciovolcanic landforms formed because of the interaction of an active part of the mid - Atlantic ridge mantle plume on going volcanism with a large overlying large intact ice cap. Some of these landforms such as tuyas, tindars, volcanic dust bowls and sandurs are rare and mainly found and best developed in Iceland. The site is of world-famous scientific interest and glaciovolcanic research and has been considered as a model of the early Earth, the area's sub glacial lakes analogous to the ice satellites of Jupiter and Saturn and the landscape of Mars. The site can be seen as a world-renowned scientific field laboratory and hotspot of great geological plate tectonic interest. I have visited the Þingvellir heritage site and I am familiar with the geology of Iceland.

9. Classical Karst Slovenia (see Williams, 2008 for a general reference)

Reviewed in 2019 (criteria vii, viii, ix and x) Tentative Listed

Classical because the area is situated where the history of the birth, development and the terminology of karst landscape science, especially the poljes and dolines, were first described. Situated in the same classical karst area of the world heritage Skocjan cave site and it shares this value also with other world heritage Dinaric karst sites in Montenegro and Croatia and can be considered as an important centrepiece of a larger Dinaric karst landscape world heritage site. Have visited many karst caves and reviewed similar IUCN nominations in Vietnam and Australia.

10. Sof Omar Cave Ethiopia (Asfawossen Asrat 2015)

Reviewed in 2019 (criteria iii, v, vi vii and viii) Tentative Listed

This dry karst cave, one of the longest in Africa, was formed by a captured river that went underground through a 15.1 km maze system structurally controlled by a major set of joints 020 / 110 resulting in unusual orthogonal columns and other forms. I have reviewed a similar IUCN site Trang An, Vietnam in 2013 and have visited with interest many other karsts cave sites including the Carlsbad.

11. Badian Jaran Desert China (Goudie and Seely 2011).

Reviewed in 2020 (vii and viii) Tentative Listed

This inland site of spectacular dunes and lakes are the centre of this large, nominated area which is already part of the Alxa Desert Badain Jaran Geopark. I have reviewed the WHS Lut Desert (5.) which has similar dunes especially yardangs however not comparable with the high dune mountains and beautiful lakes of this site. I have visited the coastal Namib desert dunes but lack the lakes so are not equivalent.

12. Ha Long Cat Ba Archipelago Viet Nam (Thung D et al. 2019)

Reviewed in 2021 (vii, viii, ix and x) Significant modification to boundaries.

Ha Long Bay has been previously recognized in 1994 and 2000 under criteria vii and viii and the Cat Ba extension adds value to these criteria and under criteria ix and x builds in the outstanding limestone island ecosystem and the archipelago biodiversity of Cat Ba to further define and develop this area into a unique complete natural site. The Cat Ba extension site is a superlative tropical and subtropical ecosystem and particularly the largest limestone island ecosystem in Asia if not the world.

13. Mt Kumgang DPRK (Won-Sok Jon et al. 2020)

Reviewed in 2021 (criteria ii, iii, vii, viii) Tentative Listed

Mt. Kumgang is the typical representative of an integrated structurally controlled granite landform and has remarkable landscape diversity, outstanding natural spectacles and beauty that

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was subjected to glacial processes, an example of an important phase in the Earth's history. Have previously reviewed the similar granite landforms of Keketuohai, China Geopark which is considered as China's Yosemite and have visited Yosemite, USA.

14. Evaporitic Karst and Caves of Northern Apennines Italy (De Waele et al. 2017))

Reviewed in 2022 and inscribed in 2023 (criteria viii)

The Evaporite Karst and Caves of Northern Apennines serial property constitute the most complete and accessible examples of the karst phenomena in gypsum and anhydrite at sub-tropical wet climate conditions. So far, no World Heritage Site has included an evaporitic karst system as an outstanding universal value to be protected. The global comparative analysis shows convincingly that these sites have unique heritage characteristics and is a best example of gypsum and anhydrite karsts.

Conclusions

The reviews of these Outstanding Universal Value World Heritage natural criteria vii and viii nominations afforded the further understanding of recognizing the importance of conservation of these sites and as an essential contribution to the United Nations Sustainable Development Goals UNSDG (Gordon et al. 2017). This is of special significance for geoscience - heritage education awareness of this important subject which should be especially introduced into university undergraduate studies, especially in countries where the locations can also be visited in the field. A similar exercise could be introduced in university undergraduate biological education for natural criteria ix and x. This subject would balance other social, responsible and sustainable content in their studies (Katz, 2022)

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