
WORLD HERITAGE NOMINATION – IUCN TECHNICAL EVALUATION

SWISS TECTONIC ARENA SARDONA (SWITZERLAND) – ID No. 1179

Background note: This nomination was previously submitted under the name “Glarus Overthrust” for consideration at the 29th session of the World Heritage Committee (Durban, 2005), but was not recommended for inscription by IUCN and was withdrawn for further consideration by the State Party (Decision 29 COM 8B.3). This nomination was also originally submitted as “Glarus Overthrust”, but the State Party proposed to change this name to “Swiss Tectonic Arena Sardona” during the evaluation process.

1. DOCUMENTATION

- i) **Date nomination received by IUCN:** April 2007
- ii) **Additional information officially requested from and provided by the State Party:** IUCN requested supplementary information on 2 November 2007 after the field visit. The State Party response was officially received by the World Heritage Centre on 28 February 2008.
- iii) **UNEP-WCMC Data Sheet:** 5 references (including nomination)
- iv) **Additional literature consulted:** BUWAL/SAEFL (2001) **Legislation on the Protection of Nature and Cultural Heritage in Switzerland**; Dingwall, P., Weighell, T. and Badman, T. (2005) **Geological World Heritage: A Global Framework Strategy**. IUCN, Gland, Switzerland, 51 p.; Furrer, H. (2003) **Die Glarner Fossilien vom Landesplattenberg Engi**. Chapter 4 in Weidert, W.K. (ed.) *Klassische Fundstellen der Paläontologie*. Goldschneck-Verlag, Korb; Imper, D. (2004) **Der Geopark Sarganserland-Walensee-Glarnerland**. Separatum aus: *Berichte der St. Gallischen Naturwissenschaftlichen Gesellschaft*, pp. 101-136; Imper, D. (2004) **Die Glarner Hauptüberschiebung - Kandidatur als UNESCO-Weltnaturerbe**. Separatum aus: *Berichte der St. Gallischen Naturwissenschaftlichen Gesellschaft*, pp. 137-152; Imper, D. and Feldmann, M. (2004) **GeoPark Information 2004**. GeoPark Geschäftsstelle, 48 p.; Moores, E.M. and Twiss, R.J. (1995) **Tectonics**. WH Freeman & Co., New York; Pfiffner, A. (1992) **Alpine Orogeny**. Chapter 6 in Blundell, D.J. et al. (eds) *A Continent Revealed: The European Geotraverse, Structure and Dynamic Evolution*. Cambridge University Press; Schwitter, R. et al. (2004) **Graue Hörner: Entstehung, Natur, Nutzung**. Alpenland Verlag AG, Schaan; Van der Pluijm, B. and Marshak, S. (1996) **Earth Structure: An Introduction to Structural Geology and Tectonics**. WCB/McGraw-Hill, New York.
- v) **Consultations:** 6 external reviewers. Extensive consultations were undertaken during the field visit with: representatives of the Department of the Environment, Transport, Energy and Communications of the Federal Office for the Environment (FOEN), Swiss National Commission for UNESCO, cantonal environmental planners, political and community representatives of the three cantons involved (St. Gallen, Glarus and Graubünden), geological scientists, GeoPark representatives, representatives from the Universities of Basel, Bern and Zürich, as well as representatives from the tourist industry and other private entrepreneurs.
- vi) **Field visit:** James Powell and Pedro Rosabal, September 2007
- vii) **Date of IUCN approval of this report:** April 2008

2. SUMMARY OF NATURAL VALUES

The nominated property is located in the Glarus Alps, north-east Switzerland, and is bounded by the valleys of the rivers Rhine (to the south and east), Sernf/Linth (to the west) and Walensee/Seez (to the north). The area of the property is 32,850 ha. The property

straddles the watersheds that form the borders of the cantons of St. Gallen, Glarus and Graubünden, embracing a number of mountain groups, including seven peaks that rise above 3,000 m.

The nominated property displays excellent geological sections through a tectonic thrust, and it is this feature

that is the basis of its nomination for World Heritage status. Thrusting is the process whereby older, deeper rocks are carried onto younger, shallower rocks and is widely recognised as being a main component of mountain building. It is generally accompanied by the formation of nappes, which are geological folds with near-horizontal axes.

The Glarus Overthrust displays very clear evidence of the major tectonic processes and structures that created the whole of the Alps, and typifies fold-mountain belts around the world. Vast sheets of old sedimentary rocks were thrust northward for a considerable distance along the gently undulating fault plane of the Glarus thrust. The rock succession ranges in ages from the Verrucano group of Permian age (300-250 million years old) to Tertiary (50-35 million years old). However, thrusting has resulted in the older Permian rocks being transported over the younger rocks, so that they now cap the highest mountains in the nominated property and in different parts of the property may overlie younger Upper Jurassic, Cretaceous or Tertiary strata.

The stratigraphic sequence and structure of the Glarus Overthrust are very clearly visible throughout the region because the rock sequence is deeply cut by glacial valleys. The thrust is a very evident feature to non-specialists and can be easily observed by visitors within an area stretching approximately 30 km east-west and 20 km north-south. As a result it is possible to trace the thrust block of the Helvetic nappes over a distance of approximately 50 km, from its origin in the Surselva in the south to its front on the Säntis in the north. These clear exposures have enabled geologists to reconstruct with high accuracy the architectural detail of this part of the Alpine mountain range, informing concepts of mountain building world-wide. Detailed mapping has shown that the overthrust rocks may have been up to 3 km thick, 50 km long and 100 km wide, and were displaced northward by at least 35 km.

The nominated property is also an important site for the history of geological ideas: it was one of the first (and certainly the best known) places where the phenomenon of thrusting was recognised. It was on the basis of evidence from this area that the idea was first conceived that fold mountain ranges consist of sheets of rock piled one on top of the other. The earliest observations in the Swiss Tectonic Arena Sardona are attributed to Hans Conrad Escher (1767-1823) who was thought to be the first to draw attention to the unusual rock succession in the Glarus Alps, although it was his son, Arnold Escher, who first alluded to the concept of an overthrust in 1845. Arnold Escher's ideas were further developed by others, although it was not until the turn of the century that the theory of overthrusting was generally accepted by the leading scientists of the day. By the end of the nineteenth century the Glarus Overthrust had become

a well-known international geological site and it has continued to stimulate ongoing studies in tectonics up to the present day. Research on the property has provided new scientific revelations, with the most recent contributions providing insights, in particular through study of the Lochseiten limestone, into the role of mylonites (which is a fine-grained, compact rock produced by dynamic crystallization of rock layers along faults) in facilitating thrust movement.

In addition to the geological values that are the basis of its nomination, the property has associated natural values. In physical terms the Glarus Alps are high, glaciated mountains, rising dramatically above the enclosing narrow river valleys. Previous glaciations have left an impressive alpine landscape. Sedimentation in corries and glaciated valleys above rock steps has created alluvial plains which hold important areas of raised bogs and mires. The landscape has also been formed by landslides and as a result exhibits scars, debris fields and fallen rock masses. Indeed, the source of the largest post-glacial landslide in the Central Alpine region lies within the nominated property, above the village of Flims.

The nominated property contains an interesting fauna and flora. With decreasing elevation the high, un-vegetated zone gives way to mountain pasture, transforming into scrub and Alpine mountain forest. The natural tree line is between 1700 m and 2000 m above sea level; but where livestock has been pastured this has been lowered by 100-200 m through forest clearance. Above the tree line, mountain pastures and dwarf birch heath predominate up to an altitude of 2200 m. Overall the property contains some 800 plant species, of which 50 species are protected at the national level.

In addition, the property contains locally significant populations of mammals, including several colonies of Alpine ibex (reintroduced to the area in 1911), chamois, mountain hare and alpine marmot, while red and roe deer are found mainly in the forested area. The property features 80-90 species of breeding birds, including capercaillie, black grouse, ptarmigan, snow finch, wall creeper and golden eagle, and has regionally important reptile populations and some 90 species of butterflies. The property is also of regional importance for other sub-alpine and alpine insect species.

3. COMPARISONS WITH OTHER AREAS

The property has been nominated under natural criteria (vii) and (viii). The State Party has provided comprehensive global comparative analyses, which have been further enhanced during the evaluation process, supported by a number of geological maps and geological cross-sections, graphics and photos that illustrate and support the studies.

IUCN has carefully reviewed the comparative analyses. In the case of criterion (vii), IUCN questions the results from the comparative study prepared by the State Party, in particular the relative value assigned to other World Heritage properties. IUCN considers the approach used by the State Party is too reductive, considering primarily the scenic values of the property's specific geological features and not addressing the overall scale of the natural phenomena and the aesthetic significance of the nominated property compared to other properties.

IUCN has carried out its own analysis of the significance of the property in relation to criterion (vii) and considers it is clear that, whilst the nominated property represents a notable scenic area of the Swiss Alps, this landscape is not dissimilar to that found in a number of mountain ranges worldwide. It is not renowned as the most spectacular or significant landscape in the Alps and does not match the spectacular landscapes of the Jungfrau-Aletsch-Bietschhorn World Heritage property in Switzerland. Nor are the scale of the natural phenomena and the aesthetic significance of the nominated property greater than, for example, those of other mountain landscapes, such as Huascaran National Park in Peru and Sagarmatha National Park in Nepal, which are inscribed under this criterion. In terms of the specific geological features demonstrated by the property, IUCN considers that these values are primarily related to the application of criterion (viii) and not (vii). Therefore, IUCN considers that the case for inscription under criterion (vii) is weak and is not supported by comparative analysis and independent expert reviews.

In the case of criterion (viii), the State Party has provided a comprehensive global comparative analysis that is based on a clear methodology and has been peer reviewed by a number of leading experts. The comparative study notes that there are a number of thrust faults in the world and therefore compares in detail the geological values of the nominated property with 27 other overthrusts worldwide including in other parts of the Alps, the Pyrenees, Scandinavia, Scotland, the Appalachians (USA), the Rocky Mountains (Canada), the Peruvian Andes, the Himalayas, the Moroccan Rif, the Lewis thrust on the Alberta-Montana border in the Waterton/Glacier International Peace Park (USA/Canada), the Aritunga nappes in Alice Springs, Australia; and the South Alpine fault in the Southern Alps of New Zealand.

Seven criteria were used in the comparative study. The results show that, whilst a number of these criteria are more or less met by all the thrust faults assessed, the clear exposures of the rocks beneath and above the fault and the clear evidence of the deformation mechanisms in the rocks along the Glarus thrust fault are globally exceptional. These qualities have enabled geologists to better understand

mountain building processes and wider implications for tectonic geology. There is also general consensus that the Glarus Overthrust has played a seminal role in the development of ideas about mountain building tectonics. In addition, due to its accessibility and clear exposures of the rocks below and above the fault it is considered the most studied and researched site over a long period of time.

IUCN, in cooperation with the International Union of Geological Sciences, undertook extensive expert reviews of the nomination's comparative analysis. These reviews are unanimously supportive of the nominated property as an exceptional area. IUCN also notes that one of the seven criteria assessed by the State Party was the potential of the property to stimulate public awareness thus contributing to the objectives of "presentation" of natural heritage within the World Heritage Convention. The Glarus Overthrust is noted as having a particular distinction due to its clearly visible and accessible form and features.

IUCN further notes that tectonic features were identified as one of the thirteen themes in its 2005 thematic study on the application of criterion (viii). Relatively few properties have been inscribed on the World Heritage List under this theme. A significant reason for this is that tectonic geology is by its nature somewhat specialised and therefore sites put forward for the illustration of such values may be too narrowly defined to be accepted as being of Outstanding Universal Value.

The Swiss Tectonic Arena Sardona is one of the few areas that can sustain a claim for Outstanding Universal Value based on its importance for tectonic geology. Whilst some aspects of the property are specialised and complex, taken as a whole the highly considered comparison of the property and the breadth and depth of support from reviewers makes a compelling case that supports inscription of the property under criterion (viii). Although tectonic features such as those in the nominated property are found in most fold mountain ranges, what differentiates the nominated property from other similar sites are the magnitude and clear exposure of these features, and their ongoing contribution to geological sciences in particular in relation to mountain buildings tectonics.

4. INTEGRITY

4.1 Legal status

The nominated property has adequate legal protection. It lies within the territory of three cantons: St. Gallen (47 % of the property), Glarus (39%) and Graubünden (14%), and includes territory within 19 communes. Most of the land in St. Gallen is owned by alpine corporations, in Glarus by the communes, and in Graubünden by citizens associations.

The property does not have a single legal status, but is protected by a mixture of federal, cantonal and communal measures. Under Swiss law, sites of national importance are entered onto the Federal Inventory of Landscapes and Natural Monuments of National Importance, although responsibility for the management of these sites lies with the cantonal authorities. These authorities are mainly responsible for protection, maintenance and enhancement measures, while technical support is provided by the federal authority, which also bears a large part of the costs.

A federal inventory of geological sites (geotopes) of national importance has yet to gain legal status; however, at the cantonal level, a geotope inventory was adopted in St. Gallen in 2002, while a similar inventory was in the process of adoption in Glarus at the time of the IUCN field visit. In Graubünden, geotopes have been included in the cantonal natural and cultural heritage protection inventory, and a special inventory of geological sites within the nominated property has been compiled. At the communal level, these geotope protection provisions are included in inventories, ordinances or land use plans, if they are binding on landowners. A series of such geotopes protect the key geological features of the property.

4.2 Boundaries

The nominated property has adequate boundaries that encompasses the most important exposures of the Glarus overthrust and associated geological features. The boundary was confirmed as part of the agreement between all of the stakeholders on the establishment and management of the area for conservation, and it is marked on the commonly agreed Development Plan. It generally follows topographic features and often coincides with the boundaries of existing protected areas, thus facilitating control and patrolling. The boundary encloses the high mountains on the meeting place of the three cantons, centred on the Piz Sardona. It generally lies above 1500 m, but descends to below 600 m in two places to enclose the important geological sites at Vättis and Lochsite. The particular geography of the property, the topographically restricted access to it, and the fact that land use activities around the property are compatible with its conservation objectives, mean that there is no requirement for a buffer zone.

4.3 Management

In each of the three cantons, a master plan provides the basis for protection of the property in terms of spatial planning. The master plan, issued by the cantonal government and approved by the Federal Council, is binding on all authorities. It lists nature and landscape priority areas, many of which have also been designated as sites of national importance by the federal authorities. The cantonal plans have all

been subject to review, adoption and implementation within the last 5-6 years.

The various parties with interests in the property, including federal, cantonal and communal levels of government, have signed an agreement to establish a Management Committee which manages the property and ensures coordination between the different parties. The agreement also sets out other governance arrangements and established a Scientific Advisory Committee.

A Regional Management Plan was concluded in 2003 and is under implementation. The plan includes a binding Development Plan and a list of acceptable and unacceptable uses of the property. It also covers organisational, financial and legal aspects which provide an essential basis for the implementation of agreed measures for the conservation of the property. The Management Committee provides guidance, training and support to rangers, foresters and gamekeepers working in the area.

The provision of effective interpretation and education for visitors is regarded as a key priority by IUCN. While the Regional Management Plan outlines initiatives to further develop interpretive and educational materials and programmes, a substantial amount of public education about the nominated property already takes place through a national "Geopark Programme". A range of materials already exist, while future plans include training programmes for the tourism sector, guides and others. It is also planned that the management authority for the property, under the guidance of the Scientific Advisory Committee, will establish a documentation centre with modern web-based search facilities to make existing information more accessible.

The funding for protecting and managing existing protected areas within the nominated property is provided by federal, cantonal and communal authorities. In addition, an annual budget of CHF 160,000 (some US\$ 151,500) will be made available from federal and cantonal budgets to support the implementation of projects protecting the values and integrity of the property if it is inscribed on the World Heritage List. An additional CHF 150,000 (some US\$ 142,000) will be provided by the Sarganserland-Walensee-Glarnerland GeoPark Association and the tourism organizations operating in the nominated property. It is anticipated that the total funding required for the effective management of the property will be CHF 1,000,000 (some US\$ 946,000), of which it is anticipated that 75% will be covered by public funding and 25% from private funding.

4.4 Threats and human use

There are very few impacts from human use in the nominated property, and the property's geological

values are robust. The two exceptions are the well-known and accessible exposures of the Glarus Overthrust at Lochsite and Martin's Loch, where careful management of hammering of the exposures is required. It is also noted that the values of the property rely substantially on the continued provision of safe visitor and research access and protection of key features such as the exposures of the thrust surface.

In terms of the wider management of the area, the landscape is impacted by cattle grazing on the high mountain pastures. Trampling by cattle has led to the formation of extensive staircases or terraces on steep slopes. Not only do these have high visual impact, but they also decrease vegetation cover and plant diversity, increase soil erosion, and destabilise the structural integrity of the slopes. In some areas, such as the head of the valley of the Aua da Mulins, relatively large areas of soil have been lost through land-slipping. Further research is required to find a more appropriate balance between the economic use and protection of the sensitive ecology of the nominated property.

Other human impacts on the property are minimal, although there is use by climbers, walkers, skiers and hunters. The area is crossed by way-marked footpaths and there are overnight cabins. While skiers do not penetrate deeply into the property, there is some overlap of ski runs with the boundary of the property near Flims and Weisstannen. Hunting has a long tradition in the property, requires a hunting certificate and is well regulated and effectively controlled.

In summary IUCN considers that the property meets the necessary conditions of integrity as set out in the Operational Guidelines.

5. ADDITIONAL COMMENTS

5.1 Sarganserland-Walensee-Glarnerland GeoPark

The Sarganserland-Walensee-Glarnerland GeoPark was launched in 1999 and its area embraces the most southerly part of the St. Gallen canton (Sarganserland-Walensee) and the Glarus canton. As such the GeoPark covers all of the nominated property except for the area in the Graubünden canton. The current emphasis of the programme is placed on tourism, environmental education and research. The GeoPark project has been responsible for developing a tourism programme and a programme of interpretation of the local geology within and outside of the nominated property. IUCN considers that the complementary relationships between the nominated property and the GeoPark should continue to be strengthened.

6. APPLICATION OF CRITERIA

The property has been nominated under criteria (vii) and (viii). IUCN considers that the nominated property meets criterion (viii) based on the following assessment:

Criterion (viii): Earth's history, geological and geomorphic features and processes

The Swiss Tectonic Arena Sardona provides an exceptional display of mountain building tectonics and has been recognised as a key site for geological sciences since the 18th century. The clear exposure of the Glarus Overthrust is a key, but not the only significant, feature. The exposures of the rocks below and above this feature are visible in three dimensions and, taken together, have made substantial contributions to the understanding of mountain building tectonics. The property is one of very few tectonic sites that can be regarded as being of Outstanding Universal Value, as supported by a detailed global comparative analysis, and its geological features can be readily appreciated by all visitors. The property can be differentiated from other similar sites by the combination of the clear exposure of the phenomenon in a mountain setting, its history of study, and its ongoing contribution to geological sciences.

IUCN considers the nominated property meets this criterion.

IUCN considers, however, that the nominated property does not meet criterion (vii) based on the following assessment:

Criterion (vii): Superlative natural phenomena or natural beauty

The nominated property represents an important scenic area of the Swiss Alps showing high, glaciated mountains, rising above lakes and the enclosing narrow river valleys of the upper Rhine, Linth and Walensee. It is a notable landscape within the Swiss Alps, but is not an exceptionally scenic mountain landscape at the regional or global level. Comparative analysis does not show a compelling case for the application of this criterion. Whilst the Glarus thrust is a unifying feature of important magnitude, taken alone it is too narrow a basis to justify the use of this criterion, and it is one of many examples of such phenomena worldwide. There are also some integrity concerns in relation to this criterion, such as overgrazing and military training within the property.

IUCN considers the nominated property does not meet this criterion.

7. RECOMMENDATIONS AND STATEMENT OF OUTSTANDING UNIVERSAL VALUE

IUCN recommends that the World Heritage Committee adopt the following decision:

The World Heritage Committee,

1. Having examined Documents **WHC-08/32.COM/8B** and **WHC-08/32.COM/INF.8B2**,
2. Inscribes the **Swiss Tectonic Arena Sardona, Switzerland**, on the World Heritage List on the basis of **criteria (viii)**, noting the revision of the name originally proposed by the State Party;
3. Adopts the following Statement of Outstanding Universal Value:

Values

The Swiss Tectonic Arena Sardona presents an exceptional and dramatic display of mountain building through continental collision. The property is distinguished by the clear three-dimensional exposure of the structures and processes that characterise this phenomenon in a mountain setting, its history of study, and its ongoing contribution to geological sciences. It is one of the few sites illustrating tectonic processes that can be regarded as being of Outstanding Universal Value.

Criterion (viii) – Earth’s history, geological and geomorphic features and processes: *The Swiss Tectonic Arena Sardona provides an exceptional display of mountain building tectonics and has been recognised as a key site for geological sciences since the 18th century. The clear exposure of the Glarus Overthrust is a key, but not the only significant, feature. The exposures of the rocks below and above this feature are visible in three dimensions and, taken together, have made substantial contributions to the understanding of mountain building tectonics. The property is one of very few tectonic sites that can be regarded as being of Outstanding Universal Value, as supported by a detailed global comparative analysis, and its geological features can be readily appreciated by all visitors. The property can be differentiated from other similar sites by the combination of the clear exposure of the phenomenon in a mountain setting, its history of study, and its ongoing contribution to geological sciences.*

Integrity

The property contains the full range of tectonic features necessary to display the phenomenon of mountain building. Key attributes of the site include the Glarus Overthrust and the associated folded and faulted geological exposures above

and below it. Other key attributes of the property are the accessibility of the features in three dimensions, and access to the thrust surface of the Glarus Overthrust. Associated intangible values relate to the importance of the property as a formative site for the geological sciences; and the features that were part of these studies remain visible and in good condition in the present day.

Requirements for Protection and Management

The major exposures of the geological features are within protected areas and are substantially unthreatened. The primary management issue is to allow the natural processes of slope erosion to continue. Other key management issues relate to the continued provision of safe visitor and research access and protection of key features such as the exposures of the thrust surface. The communication of the key values of the property is also an important priority and continued investment and enhancement of visitor interpretation and education strategies are required.

4. Commends the State Party for its significant efforts in developing the nomination and enhancing the recognition of the values of the property following IUCN’s evaluation of the original nomination submitted in 2004; and notes the quality of the comparative analysis carried out in relation to the geological values of the property;
5. Further notes that the inscription of the property makes a significant contribution to the recognition of tectonic sites on the World Heritage List and that the nomination sets a high standard for the quality of argument required to support inscription of any further tectonic sites as well as for geological nominations in general; and emphasises that the numbers of tectonic sites suitable for inscription on the World Heritage List is likely to be very small.

Map 1: Location of the nominated property



Map 2: Boundaries of the nominated property

