EUROPE / NORTH AMERICA

STEVNS KLINT

DENMARK

WORLD HERITAGE NOMINATION – IUCN TECHNICAL EVALUATION

STEVNS KLINT (DENMARK) – ID No. 1416

IUCN RECOMMENDATION TO WORLD HERITAGE COMMITTEE: To inscribe the property under natural criteria.

Key paragraphs of Operational Guidelines:
Paragraph 77: Nominated property meets World Heritage criteria.
Paragraph 78: Nominated property meets integrity and protection and management requirements.

1. DOCUMENTATION

a) Date nomination received by IUCN: 20 March 2013

b) Additional information officially requested from and provided by the State Party: Following the technical evaluation mission the State Party was requested to provide supplementary information on 13 December 2013. The information was received on 28 February 2014.

c) Additional literature consulted: Various sources as cited in the nomination, together with Wells, R. T. (1996) **Earth's geological history: a contextual framework for assessment of World Heritage fossil site nominations.** IUCN, Gland; Molina, E., Alegret, L., Arenillas, I., Arz, J.A., Gallala, N., Hardenbol, J., von Salis, K., Etienne Steurbaut5, Noel Vandenberghe, E. and Zaghbib-Turki, D. (2006) **The Global Boundary Stratotype Section and Point for the base of the Danian Stage (Paleocene, Paleogene, "Tertiary", Cenozoic) at El Kef, Tunisia - Original definition and revision.** Episodes, Vol. 29, no. 4. IUGS.; Dingwall, P., Weighell, T. and Badman, T. (2005). **Geological World Heritage: A Global Framework.** IUCN, Gland.

d) Consultations: 10 desk reviews received. The mission also met with representatives from the Danish Agency for Culture, from Stevns Municipality, from the Ostsjaellands Museum, from the Danish Society for Nature Conservation, from the Stevns Tourist Association, from Landowners and Village associations, from the Danish Ornithological Society, from the University of Copenhagen, with geologists, and other experts.

e) Field Visit: Andrej Sovinc and Marie-Luise Frey, 18-20 September 2013

f) Date of IUCN approval of this report: March 2014

2. SUMMARY OF NATURAL VALUES

The nominated property, Stevns Klint, is a c.40 ha geological site that includes a 15 km long coastline with fossil bearing cliffs as high as 41 m. This rugged coastal protected area is in eastern Denmark. The nominated property includes intertidal cliffs and adjacent constructed tunnels and abandoned quarries which expose Cretaceous and Tertiary strata. A buffer zone of 4,136 ha has been defined and provides protection for 471 ha of land adjacent to the cliffs and for 3,655 ha of marine areas. The property is technically a serial property of two component parts, as there is a break in the coastal section where a quarry export quay is located at Stevns Kridtbrud.

Stevns Klint illustrates the best-known global mass extinction event in the history of Earth, which marks the Cretaceous - Tertiary (K/T) boundary. This mass extinction occurred c.65 million years ago and is particularly notable due to its association with Chixulub asteroid impact that took place in what is currently the Gulf of Mexico.

This event is marked in the stratigraphic record by a signature reddish layer with a high concentration of the element Iridium, which is associated with the asteroid impact. A boundary clay layer follows representing a period of low biological productivity, and is typically up to 10 cm thick, but at a single locality in the northern part of the cliff, it reaches up to about 30 cm. At this boundary it is estimated that more than half of all living Cretaceous species became extinct including land-living dinosaurs and large marine reptiles.

This exceptional boundary layer is easily recognizable, even to an inexperienced eye. The boundary is clearly visible and lies beneath a pronounced topographic overhang, and separates the underlying soft Cretaceous chalk from the overlying, harder Tertiary limestone. The position of the boundary varies from c. 5m below the present-day sea level in the southern part of the nominated property to c.35m above sea level in the northern part.

The Upper Cretaceous chalk deposits are generally rich in macrofossils, representing a highly diverse marine bottom-dwelling fauna. More than 450 species of macrofossils and hundreds of nanno- and microfossils have been found in the exposed chalk at Stevns Klint. The lowest part of the Tertiary Period is represented by large bryozoan limestone mounds with thick black flint.

Stevns Klint is also a classic study locality, with a special place in the theory of the asteroid-induced cause of the K/T extinction. The nominated property was one of three locales studied by a group of scientists, led by W. Alvarez, which informed the theory that the Earth had received a large amount of extra-terrestrial materials at the Cretaceous – Tertiary boundary, the basis of the idea that the Earth has been subject to an asteroid impact that led to the mass extinction.

In addition to its geological values, for which it is nominated, the nominated property also includes other notable natural values. It lies on an important bird migration route between Scandinavia and southern Europe and Africa. Species of particular conservation concern at the European level include the Sand Lizard, seven bat species, Smooth and Great Crested Newt. Two abandoned quarries are part of the European Natura 2000 network as habitats for amphibian species. At the national level, 22 butterfly species and a nationally rare spider species are found in the area. The marine area is also part of the Natura 2000 network.

The nominated property also has locally and nationally significant cultural associations, including in relation to past military history, and the production of building stone.

3. COMPARISONS WITH OTHER AREAS

The nomination has been made exclusively under natural criterion (viii), and contains a significant comparative analysis, which is relevant to three of the thirteen themes in IUCN's 2005 framework for geological World Heritage: stratigraphy, the record of life and meteorite impact.

The K/T boundary is a global phenomenon, created by an event very distant from Stevns Klint. There are many sites that contain this exposure. The nomination undertakes a comparison with 500 registered localities globally, and then a short list of these sites, to demonstrate its superlative quality in documenting the K/T boundary. This finding is partly supported by its short-listing as a Global Boundary Stratotype Section and Point (GSSP), although it was not finally selected for this status. The nomination emphasizes additional values that are relevant to World Heritage Listing in relation to the current GSSP (El Kef, Tunisia), including its ready accessibility and visibility. Details are provided in the nomination documentation, including a listing of the comparator sites. IUCN agrees that GSSP status on its own is not a good predictor of Outstanding Universal Value, and considers that the analysis of the State Party is sound in this regard.

In addition to providing a high quality exposure of the K/T boundary, the nominated property also is directly associated with the work that led to the recognition of this phenomenon, and the theory of asteroid driven extinction. It includes one historic iridium anomaly sampling points of the Alvarez group, below Hojerup Church, and is the most accessible of the three research sites that this group worked in.

There is also a significant fossil record before and after the K/T boundary layer. The faunal assemblage includes a diverse macro invertebrate fauna which expands the understanding of invertebrate recovery and evolution after the mass extinction event. IUCN did not consider that the comparative analysis had adequately considered the record of life, and the State Party responded to a request to complete the fossil site checklist that has been used by IUCN since 1996 to frame consistent advice to the World Heritage Committee. IUCN has considered this further information in an annex to the evaluation report, and considers that it greatly supports the case for the application of criterion (viii).

In relation to meteorite impact, IUCN notes the previous inscription of the major impact site of the Vredefort Dome, South Africa, which is the largest recorded energy release event on Earth. This site records an event that is larger than the Chixulub event, and is much older and not associated with a mass extinction event. IUCN considers that the Chixulub event can be regarded as equally iconic to the event that resulted in the Vredefort Dome, considering the former's dramatic association with the phenomenon of mass extinction, notably of the best-known group of animals in the fossil record, the dinosaurs.

Thus, on the basis of the unique combined association of the stratigraphic quality of the geological record at Stevns Klint, its direct association with major scientific discovery, and its demonstration of an exceptional and dramatic meteorite impact and the associated ecosystem response, evidenced in the fossil record, IUCN considers that the nominated property makes a strong case for the application of criterion (viii). In reaching this judgment, the IUCN World Heritage Panel considered that, should the Committee agree to include Stevns Klint on the World Heritage List, this would be sufficient to recognize the K/T mass extinction and thus should not be regarded as the basis for serial extensions. IUCN thus considers it would complete an adequate representation on the World Heritage List of the phenomenon of meteorite impact.

4. INTEGRITY, PROTECTION AND MANAGEMENT

4.1. Protection

The nominated property and its buffer zone are protected through a variety of European, national and local mechanisms. These include that Stevns Klint has been designated an Area of National Geological Interest by the Danish Conservation Agency at the Ministry of Environment.

The property, together with its landward buffer zone, as located within the 300 m coastal belt, is subject to the Danish Act on the Protection of Nature and Act on Coastal Protection. In summary this protection regime prohibits changes to the condition of beaches or other coastal areas, alteration of the terrain, removal of raw materials by digging or adding soil, plants, trees or bushes, but allows traffic on foot, brief occupancy and swimming at the individual's own risk. There are national and municipal regulations that provide adequate protection for the property.

In general, there are two forms of ownership in the nominated property: public (governmental and municipal) and private (associations, companies and individuals). The cliff is primarily private property with the local estate Gjorslev Gods as the largest owner (95 % of the cliff is owned by this private landowner). The State and Stevns Municipality each own 1% of the cliff and the rest (3%) is owned by other private landowners. The State also owns the abandoned quarry Holtug Kridtbrud, while Stevns Municipality owns the abandoned quarry Boesdal Kalkbrud and passages of the Cold War Fortress Stevensfort. The marine buffer zone is also State owned. Whilst traditional rights for quarrying theoretically exist inside the property boundaries, the State Party has confirmed in writing that these will not be exploited. The wider legislative protection ensures that these privately owned areas have statutory, secure long term protection in relation to the key features of the property. In addition, the IUCN evaluation mission in September 2013 was able to meet the major landowners, who confirmed their support for the nomination and the protection of the site.

IUCN considers the protection status of the nominated property meets the requirements of the Operational Guidelines.

4.2 Boundaries

The boundaries of the main coastal sections of the nominated property are defined by topographic features visible in the landscape, notably the top of the eroding cliff line. The boundaries of the disused quarries and the tunnel areas are clearly defined in relation to those features. Whilst these exposures are the result of human activities, they add relevant educational and research opportunities to the possible listing, and so make practical sense.

These different boundaries encompass the main features of geological interest. Due to continuous erosion from the sea, the profile of the cliff is constantly changing and kept fresh and well exposed. The new naturally occurring exposures have potential to yield additional fossils which in turn will enhance opportunities for future research at the site. The boundary of the nominated property accommodates the natural processes of coastal erosion, and as the cliff face migrates landwards, so does the nominated property boundaries. This approach to boundary setting corresponds to accepted good practice, already recognized in the existing World Heritage listings of the Dorset and East Devon Coast (United Kingdom) and Joggins Fossil Cliffs (Canada).

A buffer zone is outlined following the boundaries of existing areas of legal protection; landwards the buffer zone follows a national 300m coastal protection zone. The maritime buffer zone follows the boundaries of the Natura 2000 area of Stevns Klint. It covers the entire stretch from Rodvig to Bogeskow between the coastline and approximately 2 km out into the Baltic Sea, with two minor exclusions that correspond to long-standing small-scale infrastructure. The buffer zone provides both adequate landward scope to allow the natural evolution of the coastline, and adequate seaward extent to maintain natural coastal processes, and to engage in the regulation of any offshore activities that could, theoretically at least, be proposed.

IUCN considers the boundaries of the nominated property meet the requirements of the Operational Guidelines.

4.3 Management

The Heritage Agency of Denmark, Stevns Municipality and Ostsjaellands Museum representatives form the basis of the Steering Group that is responsible for the nomination. They have the responsibility for setting out general guidelines to ensure protection, conservation and presentation of the property, ensure involvement of stakeholders in the process of preparation of the Management Plan and secure funding for implementation of the Plan. The Management Plan dates from 2011.

The implementation of the Management Plan takes place in collaboration between a number of stakeholder groups, including Stevns Municipality and Ostsjaellands Museum, with collaboration of the Heritage Agency of Denmark, The Danish Nature Agency, Selskabet Hojeruplund Society, Foreningen Boesdal, Stevns Tourist Association and the Danish Society for Nature Conservation, as well as the landowners.

IUCN sought further information on the future plans for ensuring good and effective management, and the State Party has provided full details of a new organisation structure noted within the Stevns Klint Management Plan 2011, which would be implemented by autumn 2014, if the property is inscribed on the World Heritage List. This provides for a board, secretariat, a geological and local reference groups, and other working groups. Maintaining and supporting the high degree of local community involvement is central to the organisation.

The Stevns Klint Management Plan has been drawn up with high degree of inclusion of local residents, interested organizations, experts, and other stakeholders. It provides a vision, objectives and targets for the protection, presentation, and sustainable use,

including but not limited to the geological values. The plan includes objectives in relation to conservation, education, science, as well as local engagement and sustainable tourism.

Together with the legislative provisions, the Management Plan sets out an effective framework for protection of the nominated property, its buffer zone and wider landscape. Stevns Municipality has decided to contribute 3 million Danish kroner annually for five years as a supplement to the current handling of tasks of securing the values and creating a complete experience for visitors. It is also expected that considerable external financing will be procured via fundraising conducted by the operative unit. The money is earmarked for the tasks that are to be carried out pursuant to the Management Plan and for salaries of the operative unit.

Provided that the intended management structure is implemented in a timely fashion, as per the State Party's undertakings, IUCN considers that the nominated property meets the management requirements of the Operational Guidelines.

4.4 Community

There has been strong community engagement in the preparation of the nomination. During the evaluation mission, meetings were held with over 40 representatives of local communities and stakeholders; there was an exceptionally high level of knowledge and information about the World Heritage Convention. No signs of disagreement with the nomination of the property were detected. On the contrary, representatives of the local community presented a statement of agreement with the nomination. Landowners are well informed about the nomination, and supportive of it.

4.5 Threats

Past historical use of the property has had some impacts, but these are minor in relation to the geological values that are represented.

In terms of current threats, the site is substantially a naturally eroding coastline. It is forbidden to establish breakwaters which would limit wave erosion. The cliff will therefore remain under the influence of natural erosion. The only exceptions are areas in front of the historical monument in Hojerup – Middle Age church – and in front of the recreational area of the abandoned quarry Boesdal Kalkbrud, where long-standing structures maintain historical and recreational values of those areas. The risk of rockfall along the cliff should be considered as part of the natural processes that are essentially linked to every cliff area, and it will be important to continue to manage risks to visitors. The artificial exposures in quarries and tunnels will require some maintenance to keep them as safe and accessible parts of the site, and manage any overgrowth of key sections.

Impacts of the climate change will result in increasing frequency of storm events and sea-water levels. Even with increasing sea-levels as predicted for the next hundred years, the boundary of the nominated property will still be mainly above sea-level and accessibility will not be limited; however, the tunnels of the Cold War fortress may be affected from rising sea-levels. The management plan for the area includes securing the present entrance openings to the fortress from the sea by sealing them. Increased erosion rates due to the impacts of more frequent storm events is not considered a problem for the cliff itself due to width of the buffer area behind the cliff.

The nominated property, comprising the cliff with beach and part of sea-bed, abandoned quarries and tunnels of the Cold War fortress, is an area which is largely inappropriate for development due to physical constraints, topography, limited access and legislation. There is a path on parts of the upper edge of the cliff, and visitors walk on the beach. Traces of some camp fires at some places indicate the presence of mostly local fishermen, but this can not be considered as significant negative impact. The same can be said for vandalism where there is currently limited impact.

No major developments, such as extensive golf courses or wind farms, which would have negative effect on the nominated property, are allowed in the landward buffer zone according to the legislation. In the Management Plan for the area, approved by the Stevns Community, a pesticide and fertilizer-free zone of 20 m is to be established along the upper edge of Stevns Klint and, in the long term, a cultivation-free zone is to be established along the same edge of the cliff. More and larger pasture areas are to be established.

The 300m wide landward buffer zone is complemented by wider restrictions in an area extending up to 3 km landwards. This includes Boesdal Kalkbrud (abandoned limestone quarry), Cold War Museum Stevnsfort, Hojerup (historical village and today the primary entrance to Stevns Klint), Stevns Lighthouse (Stevns Fry), Mandehoved/Flagbanken (viewing and presentation area), Bogeskov and Holtug Kridtbrud (access for visitors to the nominated area with visitor's facilities, including car park). Restrictions and limitations on development are in place to maintain the character of these areas through the Management Plan, and local planning laws.

The maritime buffer zone, included in the Natura 2000 area, allows only for some small fisheries. According to the national spatial and planning schemes, no wind farms are planned for development in seaward from the nominated property.

The nominated property is interrupted with a small gap at Stevns Kridtbrud, where an active quarry exists, with a quay for seaborne export within the marine buffer zone. Extraction is permitted until 2033. The State Party notes that extraction can only take place within a clearly

specified area and there is a clear policy that no further permissions will be given for the extraction of chalk east of the Hærvejen road. As a consequence of this ruling, the extraction area cannot be extended beyond the presently specified limits and extensions outside the property could only take place at a greater distance than at present from the property. Shipping associated with the export is very limited and well regulated, but requires continued supervision and appropriate contingency plans. Continued thorough supervision of the quarry is also required to ensure its impacts on its immediate surroundings do not increase. The areas already exploited are currently the subject of rehabilitation measures. This is the only industrial site close to the nominated property, and in the very long term would be capable of restoration.

As already noted above, the State Party has confirmed that there are no extractive activities, and none will be permitted within the boundary of the nominated property. This is an essential requirement given the clear position of the World Heritage Committee that extractive industry is incompatible with World Heritage Listing.

IUCN also raised questions with the State Party regarding the approach to fossil collecting. The nomination indicates that the current visitation to the nominated property was high and that there were projections for increased visitation. Current and projected visitation has the potential to negatively impact the fossil heritage at the proposed site due to uncontrolled/poorly managed fossil collecting. Supplementary information received from the State Party indicates that significant progress has been made to address this threat. It describes the legislative framework for protection of natural heritage in Denmark, and regional and municipal planning to support the protection of the nominated property. Furthermore, guidelines that regulate collecting and also zoning the property for managing visitation along the coast have been developed. It will be essential that these protection strategies are fully implemented with appropriate resources provided.

IUCN considers that the nominated property meets the integrity, protection and management requirements of the Operational Guidelines.

5. ADDITIONAL COMMENTS

5.1 Serial property

When IUCN evaluates a serial World Heritage Property it asks the following questions:

a) What is the justification for a serial approach?
The serial approach has been taken in order to ensure exclusion of a long-standing area of continuing extractive industry from the property, at Stevns Kridtbrud. This is justifiable as such an area could not be included in the property boundary due to the position of the World Heritage Committee, and IUCN, that extractive industry is not compatible with World Heritage status.

b) Are the separate component parts of the nominated property functionally linked in relation to the requirements of the Operational Guidelines?
The two components are functionally linked as two elements of the geological exposures of Stevns Klint. The gap between the components is very small.

c) Is there an effective management framework for all of the component parts of the nominated property?
The two components are addressed by the same management framework.

6. APPLICATION OF CRITERIA

Stevns Klint has been nominated under natural criterion (viii).

Criterion (viii): Earth History and Geological Processes
Stevns Klint is a globally exceptional testimony to the impact of meteorite impact on the history of life on Earth. The property provides a representation of the evidence of the Chixulub meteorite impact that took place at the end of the Cretaceous Period, c.65 million years ago. This impact is widely believed by modern scientists to have caused the end of the Age of the Dinosaurs, and led to the extinction of more than 50% of life on Earth. This is the most recent of the major mass extinctions in Earth's history. Comparative analysis indicates this is the most significant and readily accessible site, of hundreds available, to see the sedimentary record of the ash cloud formed by the meteorite impact, the actual site of the impact being deep underwater offshore the Yucatan peninsula. In addition, the site has iconic scientific importance as the most significant and accessible of the three localities where the radical theory for asteroid driven extinction was developed through the seminal work of Walter and Luis W Alvarez, with their co-workers. Stevns Klint is highly significant in terms of its past, present and future contribution to science, especially pertaining to the definition of and explanation of the Cretaceous/Tertiary (K/T) boundary.

The outstanding fossil record at Stevns Klint provides a succession of three biotic assemblages including the most diverse end-Cretaceous marine ecosystem known. The million years recorded in the rock at Stevns Klint provides evidence of a climax pre-impact community, fauna that survived a mass extinction event, and the subsequent faunal recovery and increased biodiversity following this event. The fossil record shows which taxa became extinct and which survived and reveals the tempo and mode of evolution of the succeeding post impact fauna that diversified to the marine fauna of today, thus providing important context for the main K/T boundary layer exposed at Stevns Klint.

IUCN considers the nominated property meets this criterion.

7. RECOMMENDATIONS

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

The World Heritage Committee,

1. Having examined Documents WHC-14/38.COM/8B and WHC-14/38.COM/INF.8B2;

2. Inscribes **Stevns Klint (Denmark)** on the World Heritage List under criterion (viii).

3. Adopts the following Statement of Outstanding Universal Value:

Brief Summary
Stevns Klint is a globally exceptional testimony to the impact of meteorite impact on the history of life on Earth. The property provides evidence of the Chixulub meteorite impact that took place at the end of the Cretaceous Period, c.67 million years ago, and is widely believed to have caused the end of the Age of the Dinosaurs. The property has further iconic scientific importance due to its association with the radical theory for asteroid driven extinction developed through the seminal work of Walter and Luis W Alvarez, with their co-workers. Stevns Klint is highly significant in terms of its past, present and future contribution to science, and makes these values accessible to the wider global community as a whole.

Criteria
Criterion (viii)
Stevns Klint is a globally exceptional testimony to the impact of meteorite impact on the history of life on Earth. The property provides a globally exceptional representation of the evidence of the Chixulub meteorite impact that took place at the end of the Cretaceous Period, c.67 million years ago. This impact is widely believed by modern scientists to have caused the end of the Age of the Dinosaurs, and led to the extinction of more than 50% of life on Earth. This is the most recent of the major mass extinctions in Earth's history. Comparative analysis indicates this is the most significant and readily accessible site, of hundreds available, to see the sedimentary record of the ash cloud formed by the meteorite impact, the actual site of the impact being deep underwater offshore the Yucatan peninsula. In addition, the site has iconic scientific importance as the most significant and accessible of the three localities where the radical theory for asteroid driven extinction was developed through the seminal work of Walter and Luis W Alvarez, with their co-workers. Stevns Klint is highly significant in terms of its past, present and future contribution to science especially pertaining to the definition of and explanation of the Cretaceous/Tertiary (K/T) boundary.

The outstanding fossil record at Stevns Klint provides a succession of three biotic assemblages including the most diverse end-Cretaceous marine ecosystem known. The million years recorded in the rock at Stevns Klint provides evidence of a climax pre-impact community, fauna that survived a mass extinction event, and the subsequent faunal recovery and increased biodiversity following this event. The fossil record shows which taxa became extinct and which survived and reveals the tempo and mode of evolution of the succeeding post impact fauna that diversified to the marine fauna of today, thus providing important context for the main K/T boundary layer exposed at Stevns Klint.

Integrity
The property contains the coastal rock exposures that are of Outstanding Universal Value. There is a small break in the site where an active quarry is located, in the buffer zone, resulting in the site being a serial property. Boundaries along the cliff address and accommodate the natural erosion processes of the sea, and include the beach area where eroded blocks fall as natural erosion progresses. The landward and seaward buffer areas are adequate.

Existing human made exposures landward of the cliff also support the integrity of the site. These exposures are in areas that include two abandoned quarries and tunnels that had historically been used for military purposes. The inclusion of these areas enhances opportunities for visitor services and interpretation and supports further understanding related to the three dimensions of the paleo-seascape. These anthropogenic features, based on calculated rates of sea level rise and planned coastal management strategies, are durable as accessible exposures for hundreds of years.

Protection and Management Requirements
The property benefits from overlapping national and local legislation, and has an up to date management plan supported through local government planning strategies. The property is protected from development and will continue to evolve as a natural and unprotected stretch of coastline.

A specific organizational structure for management of the property has been designed to support management needed following inscription on the World Heritage list. The site is governed and managed through a steering group with representation from state, regional governments, and landowners including private (majority of the nominated property is privately owned) and public. The steering group is complemented by a local organization with a board of directors, a secretariat supported by a Director and Site Manager, and two standing committees (a local reference group and a scientific reference group).

There is strong community support for the nomination, and a co-management approach with a range of partners including local government, the local museum, NGOs and private sector interests. Sustained and

adequate finance for the management of the property is a long-term requirement. Project funding has been secured with a plan for securing sustainable funding based on a five-year management cycle. Ongoing management funding will be provided through the local government. Both national level and private sector involvement in the management of the site will also provide support to the property.

There are some threats to the property that require continued attention. There is notable visitation, and projections that this will increase. This has the potential to negatively impact the fossil heritage through uncontrolled/poorly managed fossil collecting. This threat is managed through the legislative framework for protection of natural heritage in Denmark and regional and municipal planning to support the protection of the nominated property. Guidelines are in place that regulate collecting and also zoning the property for managing visitation along the coast. It will be of additional importance that tourism and visitation is part of a local strategy for sustainable tourism, and that effective education, interpretation and curation facilities are provided.

The property is protected from extractive use, in line with the principle that such uses are incompatible with World Heritage Site status, and the State Party has provided a series of examples of cases where government has denied requests for extraction of resources to ensure the protection of natural heritage values. A dormant claim for quarrying adjoining the property expires in 2028 and will not be renewed, nor activated prior to its expiry.

4. Recommends the State Party, in managing the property following inscription, to:

a) establish without delay the revised and specific management system proposed to assume responsibility for the property upon inscription on the World Heritage List;
b) retain policies to ensure that no mining and/or quarrying activities take place within the property, nor any adjacent extraction activities that could impact the property;
c) ensure effective implementation of fossil collecting guidelines, including appropriate curation of key specimens;
d) ensure effective engagement of the private landowners in the protection and management of the property on an ongoing basis;
e) ensure effective presentation of the property, to provide for a high quality visitor experience, supported by appropriate education and interpretation facilities;
f) continue strong processes of local community engagement in the property, and the commendable shared management approach with local communities and stakeholders.

5. Considers that this nomination can be regarded as completing the recognition of the phenomenon of asteroid impact, and its impact on the history of life on Earth, on the World Heritage List.

Annex 1: IUCN Fossil Site Evaluation Checklist

Attention is also drawn to the supplementary information of the State Party that provides greater elaboration of a number of the points below.

1. Does the site provide fossils which cover an extended period of geological time: i.e. how wide is the geological window?
The fossil record is of high species diversity across the Cretaceous–Paleogene (K/T) boundary. The marine fossil fauna and the prominent presence of the impact layer makes Stevns Klint the best locality worldwide to show the global effect of the impact by a meteorite and the associated mass extinction. The fossil-rich succession covers the story of the mass extinction that brought an end to the dinosaurs and the large marine reptiles, and of the succeeding recovery of the marine biota. The geological window as a whole is around 1 million years, including the record of the instantaneous event of the meteorite impact, and the stratigraphic context before and after that event.

2. Does the site provide specimens of a limited number of species or whole biotic assemblages?
The nominated property includes a succession of three biotic assemblages starting with a high-diversity end-Cretaceous climax community, followed by post-impact disaster fauna, which is rapidly followed by a rich recovery fauna. These make Stevns Klint an outstanding locality to show the effect of a severe mass extinction on a climax ecosystem, including the mode and tempo of the subsequent recovery.

3. How unique is the site in yielding fossil specimens for that particular period of geological time: i.e. would this be the "type locality" for study or are there similar areas that are alternatives?
Stevns Klint is unique in presenting a highly diverse biota and a complete boundary section topping the most expanded end-Cretaceous section available. Stevns Klint is an obvious candidate as a stratigraphic boundary type locality, and was one of the primary candidates for this recognition. However the main stratigraphic type locality at El Kef was chosen for this role. That locality is rich in microfossils but compared to Stevns Klint it is very poor in macrofauna, including the large vertebrates. The State Party notes that El Kef fully qualifies as the stratigraphic type locality for the K/T boundary, but considers Stevns Klint undoubtedly is unrivalled for the study of faunal evolution across a mass extinction event. In addition the State Party considers that studies are now available that strengthens the case for Stevns Klint to be regarded as the global type section.

4. Are there comparable sites elsewhere that contribute to the understanding of the total "story" of that point in time/space?
There are many sites globally that exhibit the K/T boundary; however the comparative analysis within the nomination, and the further consideration by IUCN confirm that Stevns Klint presents the strongest case for recognition of a site as being of Outstanding Universal Value. The outstanding boundary succession at Stevns Klint not only shows the impact layer but contains the richest marine fauna known from the boundary strata at both low and high taxonomic levels. The association with the Alvarez group seminal work is also compelling.

If a serial nomination should be considered then the impact crater at Yucatán would be a candidate, if it were not for the fact that it is deeply buried and only known from boreholes and geophysical data. Thus such an idea is impractical. Conversely, IUCN considers that a serial nomination with other exposures would not be appropriate, and that the nominated property conveys the Outstanding Universal Value of the record of the K/T boundary for the purposes of the World Heritage Convention.

5. Is the site the only main location where major scientific advances were (or are) being made that have made a substantial contribution to the understanding of life on Earth?
Mass extinction has been studied at numerous locations worldwide, but Stevns Klint stands out for the study of the K/T event. The discovery of an iridium anomaly in Stevns Klint by Walter Alvarez in 1978 led to the hypothesis of an extraterrestrial impact causing the mass extinction. The seminal paper of Alvarez published in *Science* in 1980 led to increased scientific interest reflected in more than 180 papers that have since followed based on studies of Stevns Klint material.

6. What are the prospects for ongoing discoveries at the site?
Considerable prospects, as evidenced by continuing publication of papers in high-profile journals.

7. How international is the level of interest in the site?
Stevns Klint is of the highest international interest. Almost all K/T boundary scientists will have visited Stevns Klint and the site has been studied by many international teams, resulting in more than 50 scientific papers per decade since the 1980s.

8. Are there other features of natural value (e.g. scenery, landform, and vegetation) associated with the site?
The site is primarily a scenic substantially natural coastline, of national importance, with one intrusive development in its centre at Stevns Kridtbrud. It is also part of notable nature conservation areas, such as its status as an Important Bird Area, in relation to migratory birds.

9. What is the state of preservation of specimens yielded from the site?
Well preserved calcite fossils, microfossils, and casts of aragonite fossils, and very high quality preservation of teeth of sharks, ray-finned fish, and mosasaurs.

10. Do the fossils yielded provide an understanding of the conservation status of contemporary taxa and/or communities?

The mass extinction at the K/T boundary was the last of the 'Big Five' mass extinctions, and the survivors of this event form the basis for the evolution of modern life on Earth. The site also is a testimony to the potential catastrophic impact of meteorite impact on life, and to the study of how life recovers from such major global cataclysms.

Map 1: Nominated property location

Map 2: Nominated property and buffer zone