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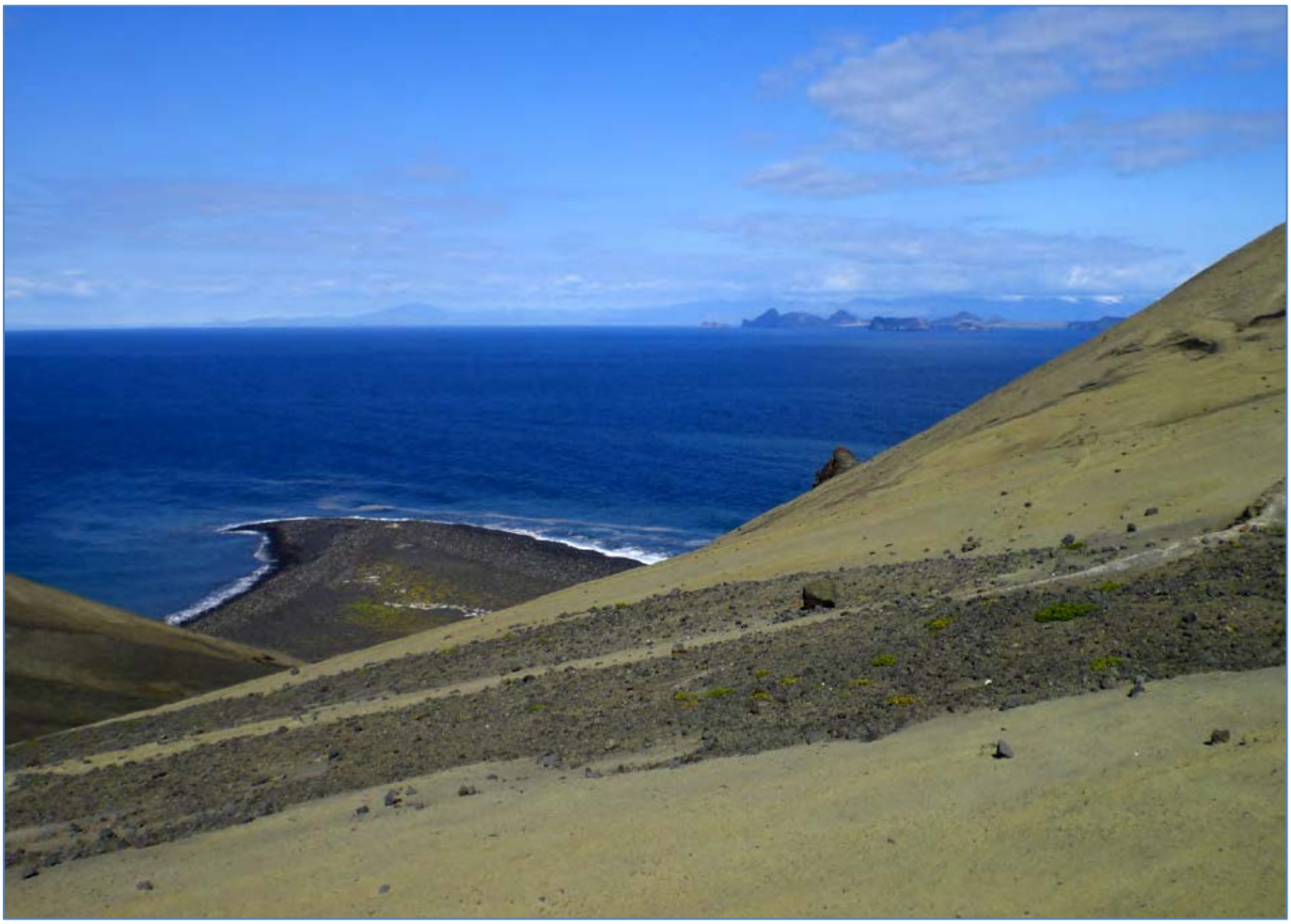
NEWS
NO. 4 2013



Surtsey is the southernmost island of the Vestmannaeyjar archipelago. A view from Surtsey to northeast. (Photo: Lovísa Ásbjörnsdóttir, 2008)

Surtsey 50th anniversary

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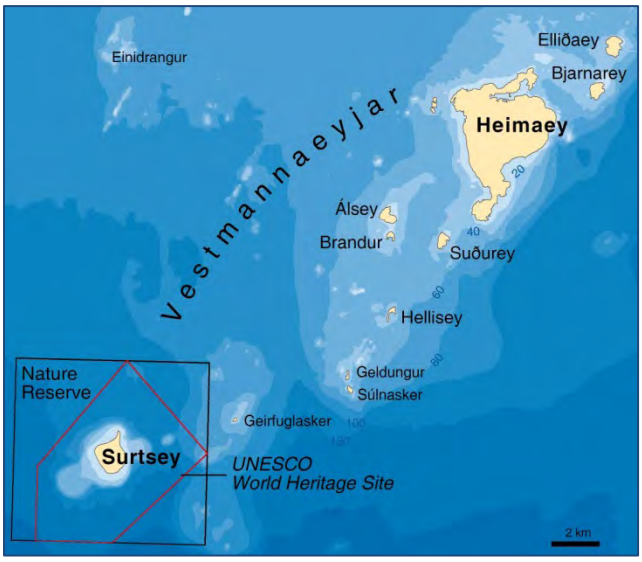
Submarine eruptions are not uncommon in the world's oceans as recently witnessed by a new volcanic island off the coast of the Japanese island of Nishinoshima. Most volcanic islands disappear soon after the eruption ends as the unconsolidated tephra has little resistance against the sea erosion. However if a stage of lava production is succeeded the island has more possibility to survive. At least six new volcanic islands have been recorded off the coast of Iceland since the year 1200, but Surtsey is the only one that has survived. In 2013 we celebrated the 50th anniversary of the unique volcanic island of Surtsey, the southernmost island of the Vestmannaeyjar archipelago and of Iceland.

Vestmannaeyjar archipelago

The Vestmannaeyjar archipelago is a group of 18 islands along with a number of skerries and seamounts located 10 km south of Iceland. Heimaey (13.6 km^2) is the largest island, followed by Surtsey (1.3 km^2). The islands are the subaerial part of a predominantly



The Vestmannaeyjar archipelago. (Icelandic Institute of Natural History, 2007)

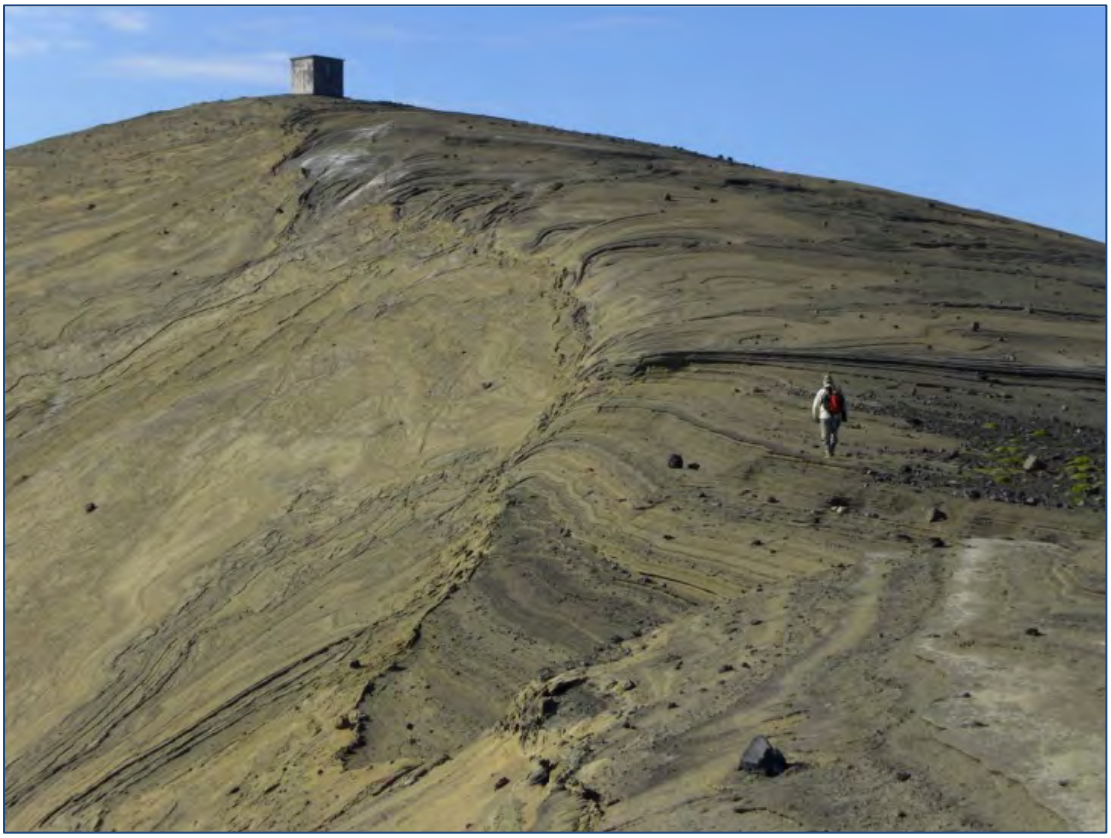
submarine volcanic system, with Heimaey at its centre. Volcanic activity, mainly submarine, began approximately 100,000 years ago. The oldest geological formation above sea level formed 40,000 years ago at the northern end of Heimaey. At least 24 eruptions have occurred during the last 10,000 years, two of them in historical times: the Surtsey eruption (1963-67) and the Heimaey eruption (1973).

The Surtsey eruption

On November 14th 1963, fishermen noticed volcanic activity in the sea 18 km southwest of Heimaey. The following day, a small island emerged, later named Surtsey. The Surtsey eruption lasted almost continuously until June 5th 1967 and is the longest eruption since the settlement of Iceland.

The volcanic activity began as a submarine fissure at a depth of 130 m. In the beginning the eruption was characteristically explosive, caused by the easy access of seawater to the erupting vents and thick black columns of ash rose 9 km into the air. This type of eruptive activity is now internationally known as a Surtseyan eruption. In April 1964, the explosive activity ceased when seawater no longer had access to the vent, and lava began flowing in Surtsey.

In 1964-1966 three smaller volcanoes, Surtla, Syrtlingur and Jólnir, rose from the seabed close to Surtsey. Surtla (1964) never reached the surface, while Syrtlingur (1965) and Jólnir (1965-66) formed islands that were quickly eroded by the sea once eruptions ended. Today the Surtsey crater system forms a 5.8 km long ridge, mostly submarine, covering a seabed area of 13.2 km^2.



The eastern tuff cone, Austurbunki in Surtsey, and the old lighthouse at the top. The tephra layers in Surtsey have consolidated into palagonite tuff due to hydrothermal activity. (Photo: Lovísa Ásbjörnsdóttir, 2008)

When the Surtsey eruption ended in 1967, the island's surface area was 2.6 km^2 rising to a height of 170 m above sea level and about 300 m above the original seabed. The island eroded rapidly during the first few years after the end of eruptions, and by 2012 Surtsey measured only 1.3 km^2. Its highest point is now 155 m above sea level.

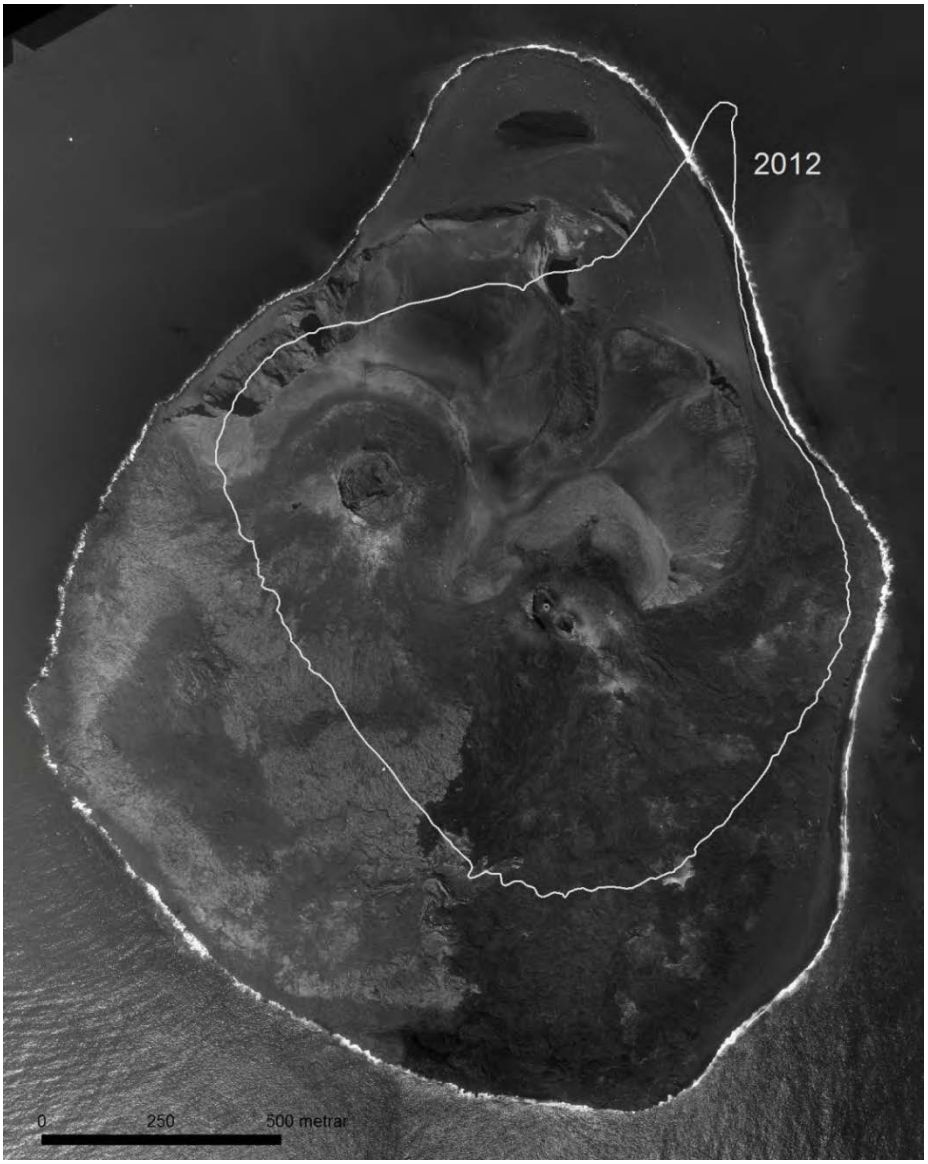
Research in Surtsey

From the beginning, Surtsey has been a pristine geological and biological research laboratory. Surtsey has provided the opportunity to monitor the origin and evolution of a volcanic island along with plant and animal colonization. This has resulted in over 600 scientific papers.

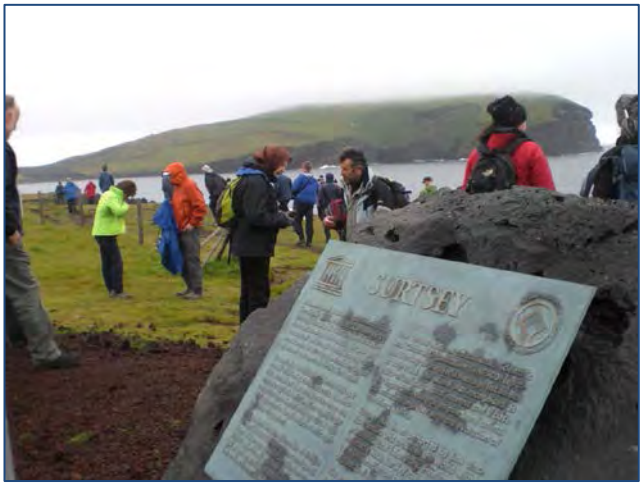
Scientists and enthusiasts interested in monitoring and protecting Surtsey founded the Surtsey Research Society in 1965. The Society's main purpose has been to co-ordinate and promote research on the island and the results of scientific research has been published in the Surtsey Research.

Aerial photos have been taken systematically, a total of 58 aerial photoset, 19 of which were taken during the eruption. Also several bathymetric maps were compiled during and after the eruption. This documentation for a juvenile volcanic island is unique.

Surtsey has provided a unique opportunity to study the evolution of a posteruptional hydrothermal system. The hydrothermal activity was discovered in the spring of 1967 and has been monitored ever since. Since 1995 the surface temperature appears to be declining by about 1°C annually.



Aerial photo of Surtsey from 1967 with the outline of the island from 2012. Only half of the island remains. (Icelandic Institute of Natural History, 2013)



At the Surtsey conference one day field excursion was to Heimaey, Vestmannaeyjar. (Photo: Lovísa Ásbjörnsdóttir, 2013)

Geological studies at Surtsey have for the first time demonstrated that the conversion of tephra into palagonite tuff is a posteruptional process, occurring at relatively low temperatures, usually below 100 °C and at low pressures. The process is shown to be highly temperature dependent and proceeds much faster that anyone had envisaged. The first sign of palagonitisation was noticed in 1969 at the surface of Surtsey but now some 85% of the tephra piles above sea level have been converted to palagonite tuff. Surtsey has provided a well-documented case of the consolidation and alteration of basaltic tephra.

Surtsey also offered unique opportunities to study erosive forces in a coastal environment of strong wave activity. The erosion of Surtsey has been documented in detail through the series of aerial photos. The three principal geological formations of Surtsey; tephra, lava and palagonite tuff react quite differently to marine abrasion, with tuff being most resistant. Since 1967 about half the island has been eaten away, mostly loose tephra and lava.

The Surtsey Nature Reserve and UNESCO World Heritage site

Surtsey was declared a nature reserve in 1965 when the eruption was still in progress and protection was limited to the subaerial part of the volcano. The protected area was enlarged considerably when the island was nominated to the World Heritage List in 2006. The restricted zone currently covers the entire Surtsey volcano and the surrounding sea, a total of 65 km^2. Human visits to the island have been restricted since 1965 and permission must be obtained from the Environment Agency of Iceland before going onshore.

Surtsey was accepted into the UNESCO World Heritage List in July 2008, when UNESCO recognized it as a site of unique natural interest and a base for vital research into plant and animal colonization and into the establishment and development of its ecology (criterion ix). However, Surtsey was not recognized as a unique natural interest based on earth's history, significant ongoing geological processes, the development of landforms, geomorphic or physiographic features (criterion viii).

The far-sighted protection of Surtsey in 1965 and careful scientific monitoring and research into the ecosystem and geology of the island underpin Surtsey's presence on UNESCO's World Heritage List.

Surtsey 50th anniversary conference

Surtsey 50th anniversary conference; Geological and Biological Development of Volcanic Islands, was held in Reykjavik 12-15 August. Over 75 participants attended the conference with common interest in the geology and biology of volcanic islands. 46 scientists presented their research and 20 posters where presented. In the geology sessions Surtsey was the main topic but other topics were the volcanic islands Capelinhos in Azores (1957-58), Zubair in the Red Sea (2011-2012), as well as the submarine eruption off El Hierro in the Canary Islands (2011-2012). One session was dedicated to the protection of volcanic islands and areas.

At the conference it was clear that international researchers of volcanic islands are interested in the results from Surstey research and the continuous monitoring of the island the past 50 years.

More research has been carried out in Surtsey than on any other volcanic island. We are proud of the scientists that have been studying Surtsey´s nature. Their contributions to the natural sciences are invaluable and of great importance.

Reference:

Snorri Baldursson and Álfheiður Ingadóttir (eds.) 2007. Nomination of Surtsey for the UNESCO World Heritage List. Icelandic Institute of Natural History, Reykjavík, 123 pages.

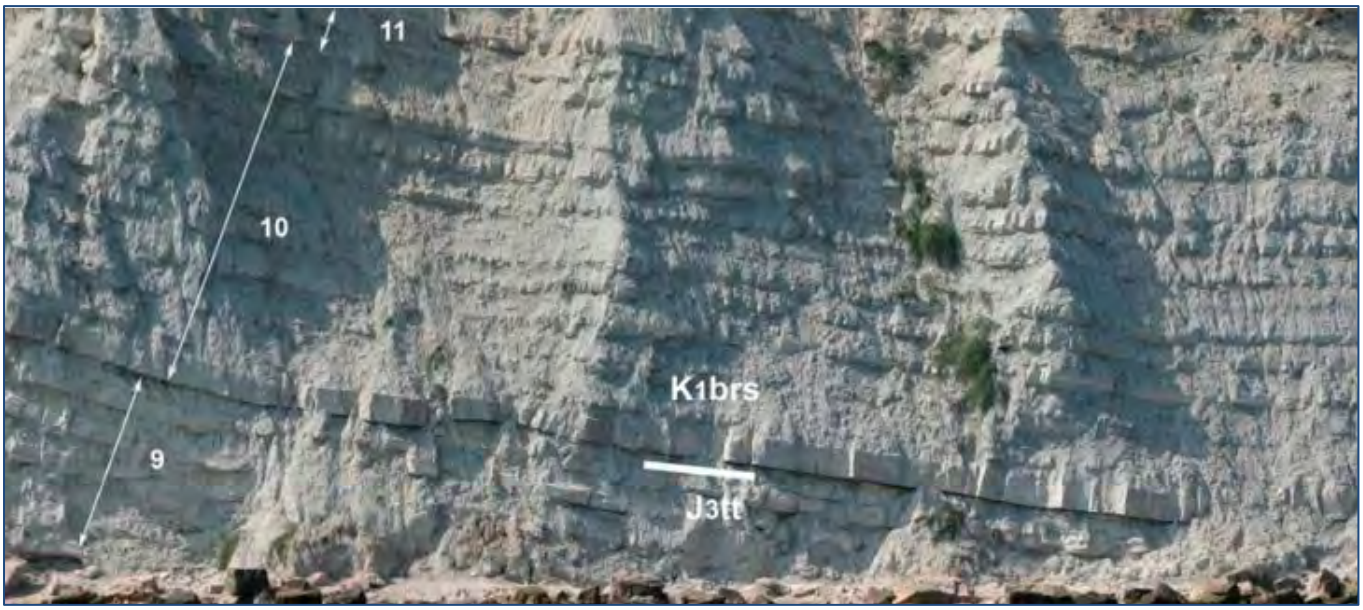


Fig. 1. Proposed position the boundary between the Jurassic and Cretaceous systems by V. Arkadiev opinion (photo V. Arkadiev)

Urgent need for conservation of the stratotype of the Jurassic Cretaceous boundary in Crimea

Kateryna Derevska[1], Olena Pylypchuk[2], Galyna Anfimova[1], Volodymyr Grytsenko[1], Kseniia Rudenko[1] and Yuriy Veklich[2]
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The International Geological Time-Scale have been the subject of improvement and increased precision during the last few decades. IUGS and other international geological associations support several integrated studies of Tethyan Jurassic/Cretaceous boundary sections from different countries. Results have been published, but the identification of the Jurassic/Cretaceous boundary – is the only system boundary within the Phanerozoic that has not been fixed by GSSP yet. The boundary between the Jurassic and Cretaceous systems is still problematic and question for discussions [3] in Crimea.

The history of studies of the Jurassic – Cretaceous deposits and its boundary in Crimea have been conducted for more than 130 years since V.O. Kovalevsky assumed he found such sections with a transition from Jurassic to Cretaceous within the Titonian stage, which exists in the Mediterranean. V.D. Sokolov (1885), O. Retowski (1893), W. Kilian (1913), M.V. Muratov (1960), V.V. Druschits (1967, 1975), T.N. Bogdanova (1975, 1984), K.I. Kuznetsova et T.N. Gorbachik

Fig. 2. The scale of excavation works is shown on sea conservation zone (photo Yu. Veklich)

Fig.3. Destroyed slope near light house (photo Yu. Veklich)

(1985) and others paid attention to these deposits, but a common point of view about the boundary position has not been reached.

One of the best cross-section representing intervals with the Jurassic/Cretaceous boundary in Ukraine is situated near Feodosia (Crimea). This was subject of attention in ProGEO NEWS 4, 2012. It connects with a regional stratigraphic unit, the so called "Dvojakirna Suite". The Dvojakirna Suite was described first as stratigraphic unit by N. Novikov (1980) in a manuscript report about geological prospection. The author reported that suite is represented by flishoid interbedding of grey and green-grey clay; fine brecciate limestone, brown sandstone, and siderite. The stratotype is located on the slopes of the Dvojakirna Valley and on the southern slope of the Ridge Tete-Oba.

The first scientific publication about the Suite was made by Vadim Permiakov with coauthors in 1984 [4]. They indicate the stratotype in the Dvojakirna Valley. The section has 800 m thickness according to these authors. It is represented by flishoid interbedding by clay, marl and brecciate limestone. The Suite is divided in two units. The lower part consists of interbedded marls and clays with thick layers of limestone. The upper part has interbeddings of clay layers and hard "ringing" marls with thin layers of brecciate limestone [4]. The suite contains Protozoans, Coelenterata, Gastropods, Bivalves and Cephalopods which allows authors to accept age as Late Titonian – Early Berriasian. But exact position of the boundary of Jurassic and Cretaceous in the section was not indicated.

The last investigation of the Dvojakirna Suite, conducted by Vladimir Arkadiev and colleagues [1,2], resulted in a more exact description of the section. As shown by Arkadiev, flishoid clayey limestone sediments section crushed and overturned into different forms and size folds which are complicated by breaks. The total thickness of the sequence is about 360 m. The rocks dip 20-30˚ to north and north-east. The suite basement outcrop on the southern slope of the Tete-Oba syncline. The upper part of the section was found on cape Elias. The authors consider that the suite is built by deep-water shelf sediments. The aggregate sequence consists of four sections and 23 units. Two sections are located in the Dvojakirna Bay (Valley), the first one - 1km on the south-east from the settlement Yuzhne and the last one is on the coast of Cape St. Elias.

V. Arkadiev and collegues [1,2], do now point to the exact position of the boundary in the Dvojakirna Suite section based on Ammonites distribution data. The interval between the levels of Late Titon and Early Berrias Ammonite findings is nearly 40 m on average.

The boundary is indicated at the base of the *jacobi* zone. The zone could be useful for correlation from Spain to the Himalayas. As results of fossils joint investigations, lithology and paleomagnetic affinities by Russian scientists, the Dvojkirna Suite sections established the position of the Titonian-Berriasian boundary (proposed as J/K boundary for the international stratigraphic commission) at the Cap St. Elias, East Crimea near Feodosia (fig. 1).

About two years ago W.A.P Wimbledon with colleagues visited Feodosia and performed investigations on cape St. Elias, but the data from this work do not yet establish a fixed J/K boundary in Crimea [7]. These extremely important localities are now under threat (see ProGEO NEWS 4, 2012). Yuriy Veklich, has recently checked the situation and taken some pictures which show the scale of excavation (see fig. 2 and 3).

The excavation has temporarily stopped because of weather condition that put obstacles in the way of terracing. But it could be continued this year. As far as we know there is going to be established a sport complex with a diving club here. The project was adopted by the State Architectural and Building Inspectorate of the Autonomic Republic of Crimea without environmental control.

Cape St. Elias is a place where there also are found populations of rear plants Lepidium turczaninowii (1) (fig. 4) and Trachomitum venetum subsp. sarmatiense (2) (fig. 5), which are listed in the Ukrainian Red Book [5, 6]. The Sea shore is formally protected by Law, but this legislation seems to be ignored by decision makers.

We consider the construction work as illegal because it is carried out in buffer zone of the sea cost. This activity was the reason to send a request letter to the Ministry of Ecology and Natural Resources of Ukraine.

Fig. 4. Lepidium turczaninowii. Photo: Pavel Evseenkov © 2011

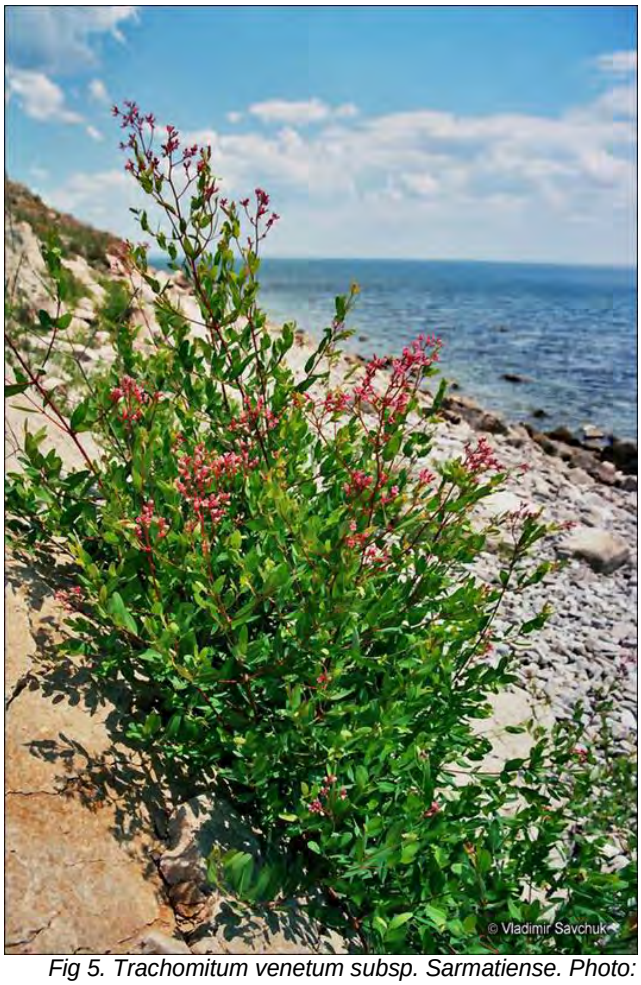

Fig 5. Trachomitum venetum subsp. Sarmatiense. Photo: Vladimir Savchuk © 2008

The answer we got from caretaker head of State Azov-Cheromorsky environmental inspection M.O. Masenko was that there is no construction going on at the moment. *The activity was made by staff from the cooperative "Blagovest-3" which have a "Permission for prepared work" from the "State Architectural and Building Inspectorate of Autonomic Republic of Crimea" and "Opinion letter about ground area 4,8156 ha for placement Resort and Rest Complex with Diving Club" from State enterprise "Crimean Scientific, Research and Design Institution on Land Management" and "Declaration about execution starting construction work, based on a Decision of twenty seventh session fifth convocation of Feodosia town council (22.02.2008)*.

The works do serious damage to a geological section of international scientific importance, natural landscape and native flora. We have decided to send a letter to the Feodosia town council to explain the importance of the section. We see the work as a direct violation of requirements which are assigned by the Environmental legislation of Ukraine. First, the stratotype located near the Feodosia lighthouse is definitely surrounded by a conservation area. Second, the work results in damage

on the coastal defense belt. We have tried to organize cooperation with other representatives of nature protection in Ukrainian Scientific centers and Crimean civil organizations. A conference this year which was dedicated 120 anniversary of birthday academician O.E. Fersman discussed the matter and a support for declaring a Geosite here was adopted by the members of the conference.

The area in question holds several sites with geological value. Some of them are already destroyed by this work and some are under threat. To limit the damage and stop the threat to international geoheritage in the area several steps are needed:

- The decree of the Feodosia town council should be immediately annulled.
- An inventory of the remaining geological values should be done and all threats to these stopped.
- An investigation of remaining values in the area already affected by the construction should establish if these now are totally damaged or if remaining values can be incorporated in the future land use of the area.
- A GEOSITE "Cap St. Elias" should be established to supplement and strengthen already existing nature protection zone in adjacent area. The formal protection of red listed species in the area is not binding for land use.
- The sequence should be further studied by modern methods for example by the Institute of Geological Science NAS of Ukraine involving national expertise on nannoplankton to indicate exact position of J/K boundary.

Arkadiev and colleagues issued a monograph last year. In the book they present the results of litho-, bio- and magnetostratigraphic studies of the Mountainous Crimea Berriasian including the sequence near Feodosia. Characteristics of the main types of the Berriasian sections are given and formational stratification of the Berriasian deposits are substantiated. A total of 159 ammonite, aptychi, bivalve mollusk, brachiopod, tintinnid, dinocyst, and ostracod species are described. The Jurassic/Cretaceous boundary is traced in the continuous Feodosia sequence of the Upper Tithonian - Lower Berriasian of the Eastern Crimea after bio- and magnetostratigraphic data [2].

We hope this book can form a scientific base for establishing a GEOSITE "Cap St. Elias and prevent further destruction in the area. We work to attract the attention of the matter from the Chief of the Environment Ministry and Directorate Institute of Geological Science.

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Coming events

The XX Congress of Carpathian Balkan Geological Association, CBGA 2014

The Organizing Committee of CBGA 2014 would like to invite you to attend the XX Congress of Carpathian Balkan Geological Association, a jubilee Congress, which will be held from 24 to 26 September 2014 in Tirana, Albania.

Please visit http://www.cbga2014.org/. Now the second circular is available for download. Please note Special session SS13: Geoheritage and geotourism.

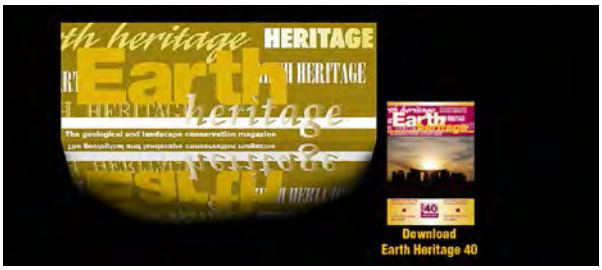
European Geosciences Union (EGU) - General Assembly, Vienna 27 April - 02 May 2014

http://www.egu2014.eu/home.html

Sessions of special interest:

Geoheritage: *Integrating geo- and biodiversity research.* Convener: Emmanuel Reynard. Co-Conveners: Jose Palacio, Grazina Skridlaite, Hanneke van den Ancker.

Geoethics: Ethical Challenges In Communication, Geoeducation And Management of Natural Hazards Convener: Silvia Peppoloni. Co-Conveners: Susan W. Kieffer, Eduardo Marone, Yuriy Kostyuchenko, Joel Gill



Earth Heritage, the UK's geological and landscape conservation magazine, is available in downloadable electronic format at www.earthheritage.org.uk. The magazine showcases geodiversity conservation and promotional activities and is published twice a year, in late winter and late summer. Back issues are also available.

Deadline next issue of ProGEO NEWS: Mars 15th 2014

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