Title: Message in a stainless steel bottle thrown into deep geological time

Author: M. Lewandowski, M.A. Kusiak, Ł. Michalczyk, D. Szmigiel, E. Sledziewska-Gojska, Barbara Barzycka i in.

Citation style: Lewandowski M., Kusiak M.A., Michalczyk Ł., Szmigiel D., Sledziewska-Gojska E., Barzycka Barbara i in. (2017). Message in a stainless steel bottle thrown into deep geological time. "Gondwana Research" (Vol. 52 (2017), s. 139-141), doi 10.1016/j.gr.2017.09.005

Gondwana Research 52 (2017) 139–141

Contents lists available at ScienceDirect

Gondwana Research

journal homepage: www.elsevier.com/locate/gr

GR letter

Message in a stainless steel bottle thrown into deep geological time

M. Lewandowski [a], M.A. Kusiak [b,*], Ł. Michalczyk [c], D. Szmigiel [d], E. Sledziewska-Gojska [e], B. Barzycka [f], T. Wawrzyniak [a], B. Luks [a], T. Thordarson [g], S.A. Wilde [h], A. Hoskuldsson [g]

[a] Institute of Geophysics, Polish Academy of Sciences, Ks. Janusza 64, PL-01452 Warszawa, Poland
[b] Institute of Geological Sciences, Polish Academy of Sciences, Twarda St, PL-00818 Warszawa, Poland
[c] Institute of Zoology and Biomedical Research, Jagiellonian University, Gronostajowa St 9, PL-30387 Kraków, Poland
[d] Instytut Technologii Elektronowej, Al. Lotników St 32/46, PL-02668 Warszawa, Poland
[e] Institute of Biochemistry and Biophysics, Polish Academy of Sciences, Pawińskiego St 5a, PL-02106 Warszawa, Poland
[f] Faculty of Earth Sciences, University of Silesia, Będzińska 60, PL-41200 Sosnowiec, Poland
[g] Faculty and Institute of Earth Sciences, University of Iceland, Askja Sturlugata 7, 101 Reykjavík, Iceland
[h] Department of Applied Geology, Curtin University, PO Box U1987, WA 6845, Perth, Australia

ARTICLE INFO

Article history:
Received 22 September 2017
Received in revised form 23 September 2017
Accepted 23 September 2017
Available online 28 September 2017

Handling Editor: M. Santosh

Keywords:
Time capsule
Svalbard
Precambrian
Language of 'objects'

ABSTRACT

In the 60th year after the placing of the corner stone under the Polish Polar Station at Hornsund (PPSH; Spitsbergen, Svalbard, Norway), a new capsule has been laid down in the vicinity of the PPSH. It is made of stainless steel, and includes five stainless steel containers, each carrying a message on different themes in our lives. The message is written in the language of objects, each of them speaking for itself. The capsule with containers has been buried in a 4.2 m deep hole, drilled for scientific purposes. The host rocks for the capsule are the Precambrian gneisses, representing the basement of the polar archipelago. We estimate that the capsule, now some 6 m a.s.l., will appear again on the surface after ca. 0.5 Ma, due to the combined effect of uplift and erosion. We also believe that it will be found, and the message understood, contrary to other messages sent by mankind into space.

1. Introduction

The year 1957 was significant for many things, but for the scientific community it is best remembered for the International Geophysical Year (IGY) that commenced on 1 July 1957. This collaborative event involved participation of over 60 countries and helped foster a thaw in the 'cold war' through the active participation of scientists from both the Eastern and Western 'blocks'. The IGY saw the launch of the first artificial satellite (Sputnik 1), led to the setting-up of NASA, the Antarctic Treaty and, for geoscientists, ultimately led to the formulation of Plate Tectonic theory, through both the identification of sea-floor spreading and the recognition of key global features in the distribution of volcanic activity and earthquakes, expertly enunciated by J Tuzo Wilson. Importantly, the polar regions were central to the initial idea behind the IGY, with a desire to build on previous 'International Polar Years' that had first involved international collaboration in 1882–1883.

One of Poland's contributions to the IGY was the setting-up of the Polish Polar Station at Hornsund (PPSH; Spitsbergen, Svalbard; Fig. 1) in 1957, where an inscribed corner stone was placed. Today, the PPSH is governed by the Institute of Geophysics, Polish Academy of Sciences. Corner stones are placed into foundations of buildings to convey messages to future generations so as to keep them informed of key events that occurred at a specific time in our past. Taking advantage of the 60th anniversary of the laying of this corner stone, on September 17th, 2017 a commemorative capsule made of 0.6 m long stainless steel was buried in a 4.2 m deep borehole in the vicinity of the PPSH (Fig. 2). According to our knowledge, it is first such a project of its kind in the world.

The borehole, originally drilled for scientific purposes, passed through the permafrost active layer, piercing Quaternary deposits and the Precambrian bedrock. The stainless steel capsule includes five smaller containers with the aim of providing any future discoverer some indication of our knowledge of the natural history of the Earth in 2017, so as to appreciate our level of technological development through the use of the universal language of identifiable objects. For technical details and full inventory of the objects loaded into the capsule see the web page: timecapsule.igf.edu.pl.

As the future discoverer naturally remains unknown, the items represent different levels of sophistication. The main themes of our "message in a bottle" (apologies to The Police) were time, life, and silica. It has been estimated, given the current uplift *versus* the rate of erosion (Vågnes and Amundsen, 1993), that the time capsule, now some 6 m a.s.l. will appear again on the surface after about 500,000 years.

* Corresponding author.
E-mail address: monika.kusiak@twarda.pan.pl (M.A. Kusiak).

https://doi.org/10.1016/j.gr.2017.09.005

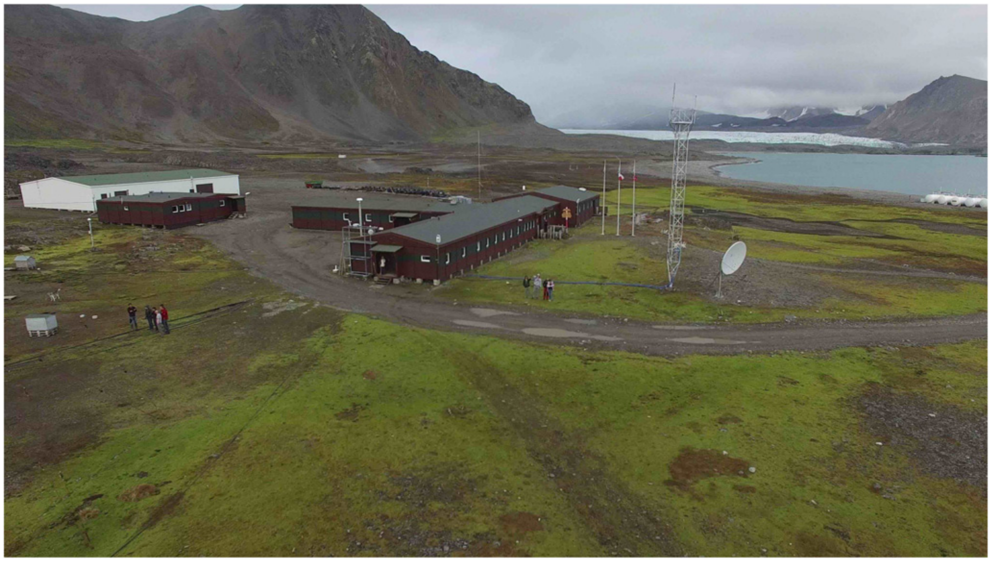

Fig. 1. The Polar Polish Station in Hornsund (Svalbard, Norway). Photo by Barbara Barzycka, taken in the summer of 2016.

2. Geology

The first container is devoted to geology. It includes a piece of the oldest material identified in the Solar System, represented by 8.4 g of the Pułtusk (Poland) chondrite meteorite, considered to be 4.5 billion years (Ga) old. The early Earth is represented by the oldest known zircon ($ZrSiO_4$) grains, extracted from the Jack Hills in Western Australia (*circa* 4.4 Ga) (Wilde et al., 2001), the Napier Complex in Antarctica (*circa* 3.8 Ga) (Kusiak et al., 2013; Williams et al., 1984), and from Labrador in North America (*circa* 3.7 Ga) (Kusiak et al., 2017). These grains were mounted in epoxy resin together with the TEMORA 1 reference zircon extracted from the 416 million year old (Black et al., 2003) Middledale Gabbroic Diorite (Lachlan Orogen, Australia). Analytical pits made by ion beam analysis are still visible, proving our ability to determine elemental and isotopic composition, fundamental for establishing the geochronological time scale. A few millimetre-sized chips of the host rocks were also mounted in the epoxy disc. Other samples in the capsule represent major stages in Earth's evolution: a fragment of banded iron formation (BIF, witnessing the advent of the Great Oxidation Event, GOE), a Cambrian trilobite (the beginning of the skeletal animal explosion on Earth), Permian red beds (accompanying the greatest mass extinction of life on Earth), an ammonite (revival of life in the Mesozoic), and a basaltic lava from the 2014–2015 CE eruption in Holuhraun (Iceland). Using its isotopic signature, the latter may serve for time identification of when the capsule was sent into the future. A sample of sand, collected from an abandoned diamond mine on the Namibian bank of the Orange River (including a kimberlite fragment and sub-millimetre-sized diamonds), is to inform the discoverer that we understood “the message from the mantle” and how the continued inner activity of Earth has enabled it to become a habitable planet. All samples were arranged in stratigraphic order.

Fig. 2. The time capsule (of 0.6 m long) and its hosting of the Precambrian gneisses of Hornsund in the vicinity of the Station. Note a shekel attracted by neodymium magnets inside, which are producing magnetic pillows separating the containers. Photo by Adam Nawrot, taken 17th September 2017.

3. Current environment in Hornsund

The second container hosts a specimen of the Hans glacier placed in a glass vessel of 200 ml volume and sealed with epoxy resin. A sample of coal, reindeer antlers, and a local shellfish were also included. When analyzing the oxygen isotopic composition of the shellfish, one may infer the present-day water temperature at Hornsund. Identical sets of various photographs and movies (total of 12 GB) were also stored on two (the first likely to be spoiled by the discoverer in order to learn how to decode the second one) high-speed memory cards. They record the present-day life on Earth, with a focus on Spitsbergen. Additionally, two bird's-eye view photos portraying PPSH in winter and summer were inserted. To prove our ability in space exploration, a photograph of the Earth taken from a distance of 1 million miles by the NASA DSCOVR satellite, with the dark side of the Moon in the foreground, was also included. All three photographs were etched into porcelain, with the expectation that they will still be legible far into the future.

4. Biology

The third container includes samples of lyophilized DNA of human (male and female) origin, as well as from vertebrates associated with humanity: rat, salmon, and a representative plant – the potato. Several micrograms of dried DNA isolated from each of these organisms were placed in tightly closed polypropylene tubes labeled in both English and Latin. Additionally, the tubes were labeled with 1–5 stripes. This simple stripe-code was also used in the attached cartoon-legend printed on a stable artificial fabric. The cartoon shows images of: DNA, a chromosome, a cell and the respective organisms.

The container also includes cryptobiotic tardigrades. Tardigrada are a phylum of microscopic invertebrates that dwell in a variety of habitats around the globe – from ocean depths to mountain tops. Given that tardigrades are aquatic animals, they require the presence of at least a film of water around their bodies in order to be alive and active. However, the great majority of terrestrial species can enter cryptobiosis, that is, a state in which no metabolic activity is detectable. Yet, a mere drop of water at melting temperature will bring cryptobiotic tardigrades back to life in no time. Moreover, when cryptobiotic, the species can survive extreme conditions, including ionizing radiation, very high atmospheric pressures or a vacuum, and temperatures ranging from -272.8 °C to $+150$ °C. Given these remarkable characteristics, we placed 300 anhydrobiotic individuals of three species representing the most common and widespread terrestrial eutardigrade genera: *Milnesium*, *Macrobiotus* and *Paramacrobiotus*, anticipating their DNA will survive for eons. Each species was placed in a separate glass tube that was sealed closed.

We also included a container of selected seeds, and a small container with deciduous teeth, as well as a bee preserved in epoxy resin.

5. Technology

The development of semiconductor electronics, in particular silicon-based integrated circuits (IC), revolutionized our civilization in the twentieth century. The fourth container is devoted mainly to Si-based objects made by the same type of technology as used for IC fabrication. Examples of microdevices include: MEMS accelerometers (miniature sensors in everyday use in mobile devices, cars, planes, various industrial applications, *etc.*), a quadrant photodiode for detection of infrared radiation and an ionizing radiation (alpha particle) detector for the transactinide elements. This box also contains a sample of quartz sand - the basic raw material for all these products, together with a piece of bulk silicon wafer, being the substrate used for IC and MEMS fabrication.

6. Everyday life

To possibly assist the discoverer in understanding the messages sent in the containers, a fifth one was prepared. It contains gadgets we use in our everyday life: a credit card, a small mobile phone, a mechanical wrist watch, coins from 25 different countries, and more!! Who knows which, if any, of these will still be utilized half a megennium later?

7. Final words

In our time capsule, we challenge our successors to solve a puzzle; the language of which is composed of natural samples and artifacts that reflect our knowledge and understanding of this unique time in history. We trust that an unknown discoverer in the distant future will be able to recognize the level of our knowledge about the Earth systems and our technological development. Our fingerprints were laid down on the polished-to-a-mirror inside parts of the container caps to sign the message. Although the boxes were prepared with the greatest care and some of the items will survive, some of them perhaps will not. Anyway, we sincerely hope that, although the mission will take a long time to come to fruition, the chances that our message will be found and (at least partly) understood are greater than zero; contrary to other such 'messages' sent previously in space missions. Time will tell!!

References

Black, L.P., Kamo, S.L., Allen, C.M., Aleinikoff, J.N., Davis, D.W., Korsch, R.J., Foudoulis, C., 2003. TEMORA 1: a new zircon standard for Phanerozoic U–Pb geochronology. Chemical Geology 200, 155–170.

Kusiak, M.A., Whitehouse, M.J., Wilde, S.A., Dunkley, D.J., Menneken, M., Nemchin, A.A., Clark, C., 2013. Changes in zircon chemistry during Archean UHT metamorphism in the Napier Complex, Antarctica. American Journal of Science 313, 933–967.

Kusiak, M.A., Dunkley, D.J., Whitehouse, M.J., Wilde, S.A., Sałacińska, A., Konecny, P., Szopa, K., Gawęda, A., Chew, D., 2017. Peak to post-peak thermal history of the Saglek Block of Labrador: a multiphase and multi-instrumental approach to geochronology. Chemical Geology (in press).

Vågnes, E., Amundsen, H.E.F., 1993. Late Cenozoic uplift and volcanism on Spitsbergen: caused by mantle convection? Geology 21, 251–254.

Wilde, S.A., Valley, J.W., Peck, W.H., Graham, C.M., 2001. Evidence from detrital zircons for the existence of continental crust and oceans on the Earth 4.4 Gyr ago. Nature 409, 175–178.

Williams, I.S., Compston, W., Black, L.P., Ireland, T.R., Foster, J.J., 1984. Unsupported radiogenic Pb in zircon - a cause of anomalously high Pb-Pb, U-Pb and Th-Pb ages. Contributions to Mineralogy and Petrology 88, 322–327.