

## PLANETARY ENVIRONMENT COMPARISON IN THE EDUCATION OF ASTROBIOLOGY.

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**Introduction:** We present examples used in the education of astrobiology at Polaris Observatory and Department of Physical Geography Eotvos Lorand University for the comparison of different planetary environments in the point of view of astrobiology. Here we compare locations where heat source and substantial volume of liquid water is present in the order of  $10^3$ - $10^6$  years. These are: 1. black smokers [1] on Earth and probable Europa, 2. ice chimney as special fumaroles on Earth and probable on Mars [2], 3. young impact craters [3] on Earth, Mars, Europa and Titan.

**Common aspects:** 1. Heat source for chemical activity, 2. local concentration of elements otherwise present in low concentration, 3. environments with various chemistry next to each other in 10-100 m distance, 4. great rock surfaces (porous volcanics, impact breccia). In Table 1. the basic characteristics, in Fig. 1. their rough p/T environment can be compared (structures are not for scale). Arrows represent trend of evolution in time, light grey area the stability of liquid water. Morphology with important locations and processes are visible in Fig. 2. for black smokers (A), ice chimneys (B) and craters (C).

**Conclusion:** This comparison help to focus the attention of students to the local p/T, chemical environment, their evolution in time and the comparison of astobiological potential of different planetary bodies.

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**References:** [1] Tivey, M. K. et al. (1990) Nature 346, 51–54. [2] Hoffman, N. and Kyle, P.R. (2003) 6<sup>th</sup> International Conference on Mars #3105. [3] Cockell, C.S. (2003) Impact structures as a habitat for martian life, 3<sup>rd</sup> European Conference on Exo/Astrobiology, Madrid.

Characteristic	Black smokers	Ice chimney	Impact craters
Location	Submarine Earth, (Europa?)	Glacial Earth, (Hellas, Mars?)	Earth, Mars, Titan, (Europa?)
Size	m -10 m (+grouping)	m -10 m (+grouping)	m-100 km
p range (bar)	Earth: 300-600 Europa: 500-1300	Earth: 1 Mars: 0.01	Earth: 1-60 Mars: 0.01-20
T range (°C)	Earth: +200 0 Europa: probably similar	Earth: +100 -20 Mars: -20 -150	Earth: +100 -20 Mars: +100 -150 Europa: +100 -190 Titan: +100 -180
Presence of water in time	continuous	Changing according to volcanism	Earth: continuous (except permafrost) Mars: decreasing
Chemistry	H <sub>2</sub> O CO <sub>2</sub> , H <sub>2</sub> S, SO <sub>2</sub> , sulfides, acidic	CO <sub>2</sub> , SO <sub>2</sub> , H <sub>2</sub> S, H <sub>2</sub> O, acidic	Target dependent, CO <sub>2</sub> , H <sub>2</sub> O, SO <sub>2</sub> release
Important locations	Near chimney surfaces, farther fallouts and dissolved	Rocky surfaces near to heat release	Water filled crater lake, rock surfaces in impact breccia
Energy source	Heat, dissolved volcanics	Heat, volcanic gas releases	Decreasing heat

Table 1. Basic characteristics

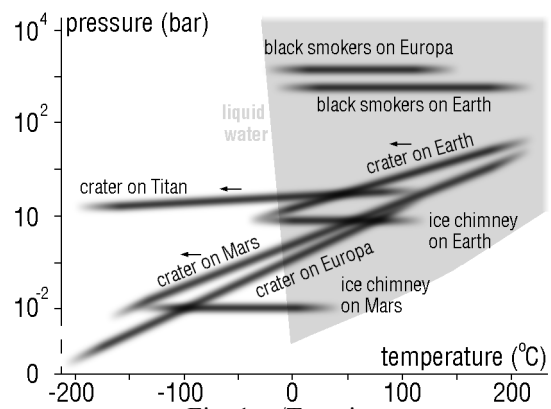


Fig. 1. p/T environments

Fig. 2. Black smokers (A), ice chimnies (B), fresh impact craters (C)

