emc$^2$020

3rd European Mineralogical Conference Cracow Poland

# Mineralogy in the modern world

# ABSTRACT BOOK

29 August - 2 September 2021

# PROGRAMME

| | oral blocks | STAGE 1 (Main Stage) | STAGE 2 | STAGE 3 | STAGE 4 |
|---|---|---|---|---|---|
| Monday 30th Aug 2021 | 9:30 – 11:15 | T1_S2 | T5_S3+T11_S1 | T2_S1 | T8_S1+T8_S2 |
| | 11:30 – 13:00 | | | | |
| | 15:00 – 17:15 | | T3_S1 | | |
| Tuesday 31th Aug 2021 | 9:30 -11:15 | T1_S2 | T10_S2+T10_S3+T10_S4 +T10_S5 | T5_S1+T7_S1 | T10_S1 |
| | 11:30 – 13:00 | T1_S3+ T1_S4 | | | |
| | 15:00 – 17:15 | | T6_S1 | T4_S1 | T12_S1 |
| Wednesday 1st Sept 2021 | 9:30 -11:15 | T1_S5 | T13_S1+T15_S1 | T5_S2 | T11_S2 |
| | 11:30 – 13:00 | | | T12_S2+T12_S3 +T12_S4 | |
| | 15:00 – 17:15 | T1_S1 | T14_S2 | | |
| Thursday 2nd Sept 2021 | 9:30 -11:15 | T9_S1+T9_S2 | T14-S1+T16_S1 | T5_S4 | T11_S3+T11_S4 |
| | 11:30 – 13:00 | | | | |

# Mineralogy in the modern world

**Following the success of the 1st and 2nd European Mineralogical Conference, the emc2020 will be focused on current and future challenges in the Earth, planetary and environmental sciences, and fostering an exchange of new views and research results between scientists from Europe and beyond.**

**The city of Kraków is a vibrant, academic and tourist city in the heart of Europe. Modern infrastructure, efficient public transportation and famous Polish hospitality make it a safe and friendly place for visitors from all over the world. The city dates back to Middle Ages and has traditionally been one of the leading centers of Polish and European academic, cultural, and artistic life. It was the capital of Poland from 1038 to 1569.**

# Welcome in Cracow!

Krakau, ክራኮው, Cracow, Cracovia, Краков, 克拉科夫, Cracó, Kraká, クラクフ, کراکوف, Cracovie, Krakov, Краків, Cra-cốp, Krakovja

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## The EMC2020 is organized by the PTMin (Mineralogical Society of Poland) on behalf of other European mineralogical societies:

**DMG** – Deutsche Mineralogische Gesellschaft
**MinSoc** – Mineralogical Society of Great Britain & Ireland
**MinSocFin** – Mineralogical Society of Finland
**ÖMG** – Österreichische Mineralogische Gesellschaft
**RMS** – Russian Mineralogical Society
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**SFMC** – Société Française de Minéralogie et de Cristallographie
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**EMU** – European Mineralogical Union
**ING PAN** – Institute of Geological Sciences, Polish Academy of Sciences
**Geo8** – GFZ German Research Centre for Geosciences

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# THERMAL AND COMPRESSIONAL BEHAVIOUR OF NATURAL BORATES: A POTENTIALLY AGGREGATES IN RADIATION-SHIELDING CONCRETES

Battiston Tommaso[1], Comboni Davide[2], Pagliaro Francesco[1], Lotti Paolo[1], Gatta G. Diego[1]

[1]Earth Sciences Department, University of Milan, Italy, [2]European Synchrotron Radiation Facility, France

Natural borates represent the first worldwide source of boron. Boron is a key constituent in different industrial sectors, including glass, ceramics, agricultural, metallurgical, electronics, textile, cosmetics, and chemistry. Recent technological developments have further expanded the use of borates, as underlined by the doubling of global production in the last decade. The recent addition (on 2014) of borates to the European Union list of Critical Raw Materials is a further evidence of the large global demand for this commodity. Due to the ability of $^{10}B$ (ca. 20% of the natural boron) to absorb thermal neutrons, related to its high cross-section for the $^{10}B(n,\alpha)^{7}Li$ reaction (~3840 barns), several recent studies investigated the utilization of natural borates as light aggregates in radiation-shielding materials, such as concretes. In this light, the use of natural borates would provide also an economic advantage: synthetic $B_4C$, for example, proved to be efficiently adopted in this field, but its use is hindered by the high costs of synthesis.

In order to characterize the phase stability field, the thermo-elastic properties, and the mechanisms of thermal-induced dehydration, we have investigated the behavior at non-ambient T and P of some of the most common hydrous borates, i.e. kernite, colemanite, kurnakovite, ulexite, and meyerhofferite, by means of in situ single-crystal synchrotron X-ray diffraction. In situ non-ambient conditions were obtained using diamond anvil cells (for high-P), nitrogen cryostats (low-T), and gas blowers (high-T). High-pressure experiments show that all the analyzed borates remain stable at pressures exceeding those to which radiation-shielding materials may be subjected. Among them, colemanite shows the lowest bulk compressibility ($K_{V0}$=67(4) GPa and $K_{V0}'$=5.5(7), where = $\partial K_{V0}/\partial P$; $\beta V0 = 1/K_{V0} = 0.0149(9)$ GPa-1). The refined isothermal bulk moduli for ulexite and kurnakovite are ~ 37 GPa ($\beta_{V0} \sim 0.0270$ GPa$^{-1}$), which lie between those of other minerals commonly used as aggregates in concretes, while kernite and meyerhofferite are slightly softer ($K_{V0} \sim 30$ GPa; $\beta_{V0} \sim 0.0333$ GPa$^{-1}$).

The high-temperature experiments on kurnakovite and colemanite show that the presence of structural $H_2O$ leads to dehydration processes that result in a structural collapse. In the light of a potential application as aggregates, this phenomenon is more critical in kurnakovite (~48% $H_2O$), where the crystal structure is no longer stable above 120 °C, while in colemanite (~22% $H_2O$) significant dehydration starts at T > 240°C. The structural collapse of kurnakovite at relatively low temperatures implies severe questions on its potential applicability in radiation-shielding concretes, while the thermal-induced dehydration of colemanite should not represent an issue for several applications of radiation-shielding materials.