Visegrad Fund

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UNIVERSITY OF CHEMISTRY AND TECHNOLOGY PRAGUE

Natural zeolites in V4 countries – analysis of sales market and applications

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prof. MEERI PAS

Webinar realized within the frame of the project titled “Natural zeolites in V4 countries – analysis of sales market and applications”, financed by Visegrad Fund.

Webinarium - participants

Agenda of the webinar

1. **Magdalena Wdowin**, *Mineral and Energy Economy Research Institute, Polish Academy of Sciences* – Natural zeolites - Genesis, properties and applications

2. **Peter Uhlik**, *Comenius University in Bratislava, Faculty of Natural Sciences* – Zeolite deposits in Slovakia

3. **Ferenc Kristály**, *Institute of Mineralogy and Geology, Miskolci-Egyetem* - Zeolite deposits in Hungary

4. **Justyna Cader**, *Mineral and Energy Economy Research Institute, Polish Academy of Sciences* – Zeolite Market in V4 Countries – general information about the report

5. **Renata Koneczna**, *Mineral and Energy Economy Research Institute, Polish Academy of Sciences* – Economic analysis of Zeolite market in V4 Countries

Title: **Natural zeolites in V4 countries – analysis of sales market and applications**

Visegrad Fund

Project Leader: Mineral and Energy Economy Research Institute, Polish Academy of Sciences

Project Partners:

1) Comenius University in Bratislava, Faculty of Natural Science, Slovakia
2) University of Chemistry and Technology Prague, Faculty of Chemical Technology, Czech Republic
3) Institute of Mineralogy and Geology, University of Miskolc

Deliverables of the project

- Report for natural zeolite market in Hungary
- Report for natural zeolite market in Slovakia
- Report for natural zeolite market in Czech Republic
- Report for natural zeolite market in Poland

Analysis of the sales market and applications of natural zeolites exploited from the V4 countries

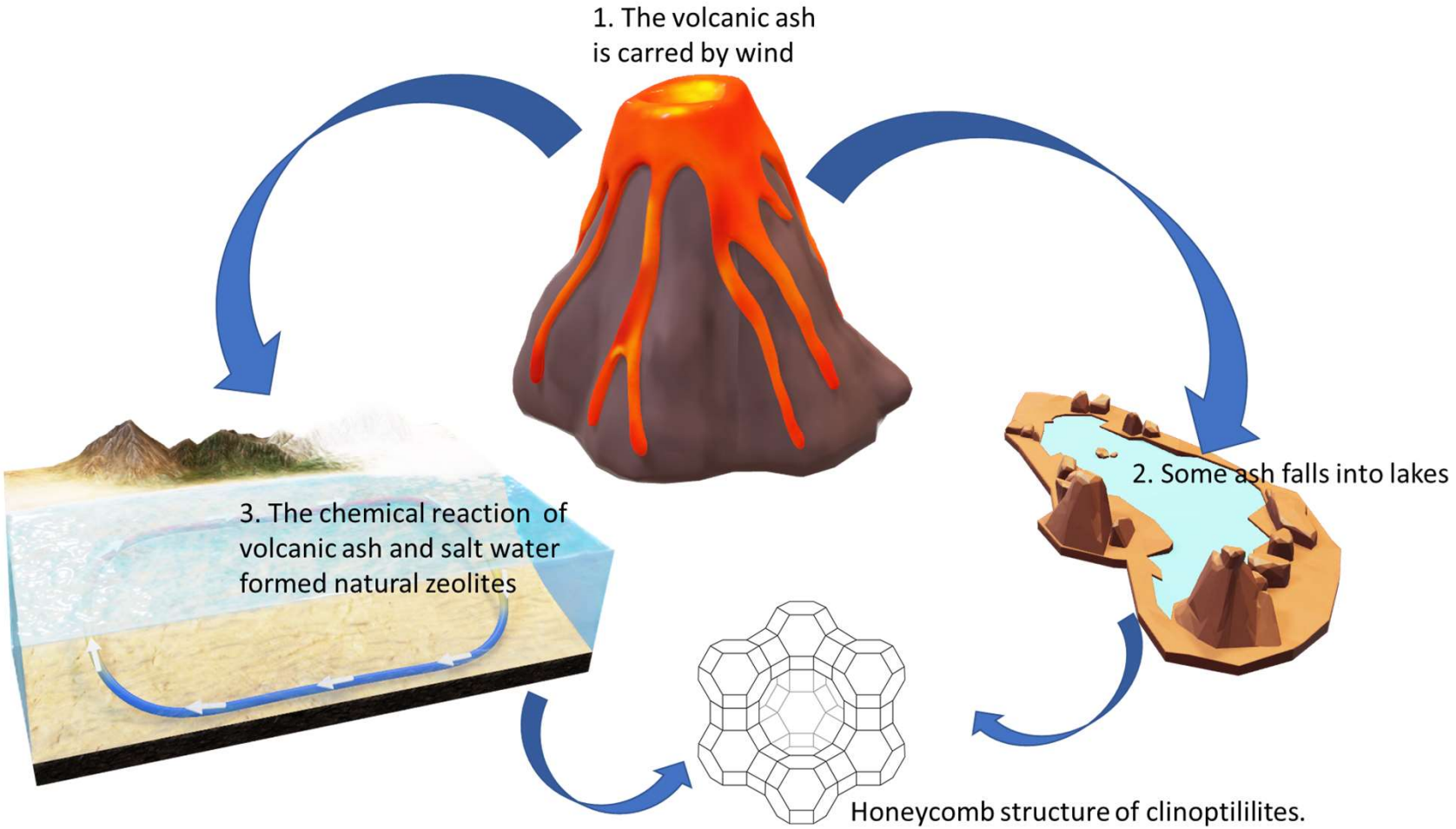
Natural Zeolites - Genesis, properties and applications

Genesis of zeolites

Zeolite formed at elevated temperatures - the zones resulting primarily by geothermal gradients	• Magmatic primary zeolites • Zeolites formed by contact metamorphic processes • Hydrothermal zeolites • Genesis in geoautoclaves • Burial diagenesis or metamorphism
Zeolites form at or near surface conditions, the zones being principally controlled by chemical gradients	• Percolating groundwater • Weathering • Alkaline, saline lake deposits
Zeolites formed at low temperature, without recognized zonation	• Marine environment
Zeolites formation in impact craters	• Impact crater

The zeolite genetic types according to Iijima (1980).

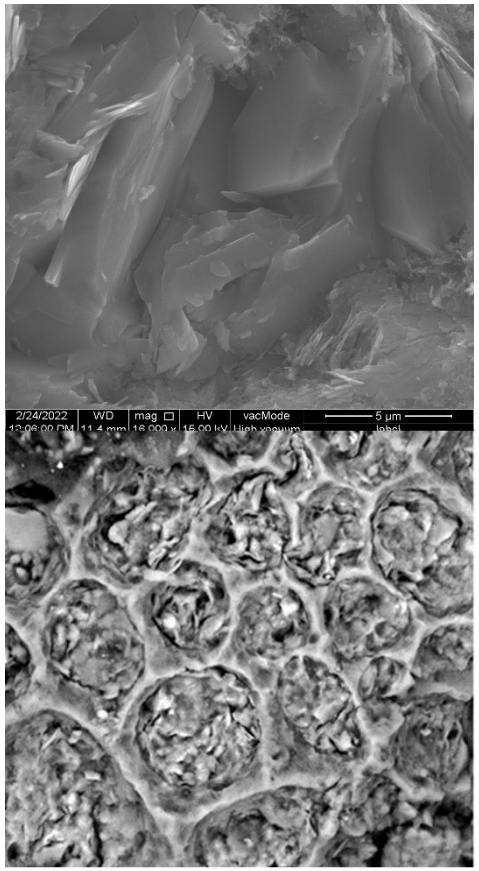
Genesis


1. The volcanic ash is carred by wind
2. Some ash falls into lakes
3. The chemical reaction of volcanic ash and salt water formed natural zeolites
Honeycomb structure of clinoptililites. Dfferences in temperature, location and ash/water properties create variation among zeolite deposits.

Properties of natural zeolites

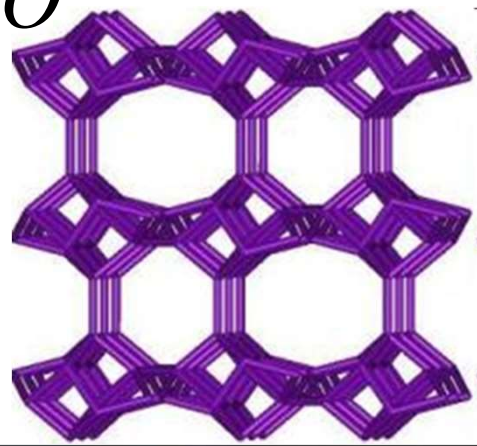
Natural zeolites are microporous crystalline materials hydrated aluminosilicates of the alkaline and alkaline-earth metals - with a structure characterized by a framework of linked tetrahedra like [SiO4] and [AlO4]− , each of which consists of four oxygen atoms surrounding a cation, that makes the zeolite negatively charged. The skeleton contains open channels and cages usually occupied by H_2O molecules and extra-skeletal cations that are commonly exchangeable (Ng and Mintova, 2008, Colella and Wise, 2014).

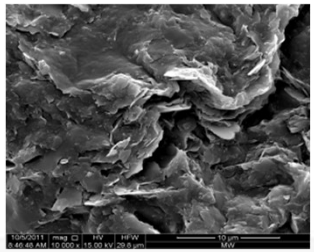
$$M^{m+}_{n/m} \times [Si_{1-n} Al_n O_2] \times nH_2O$$



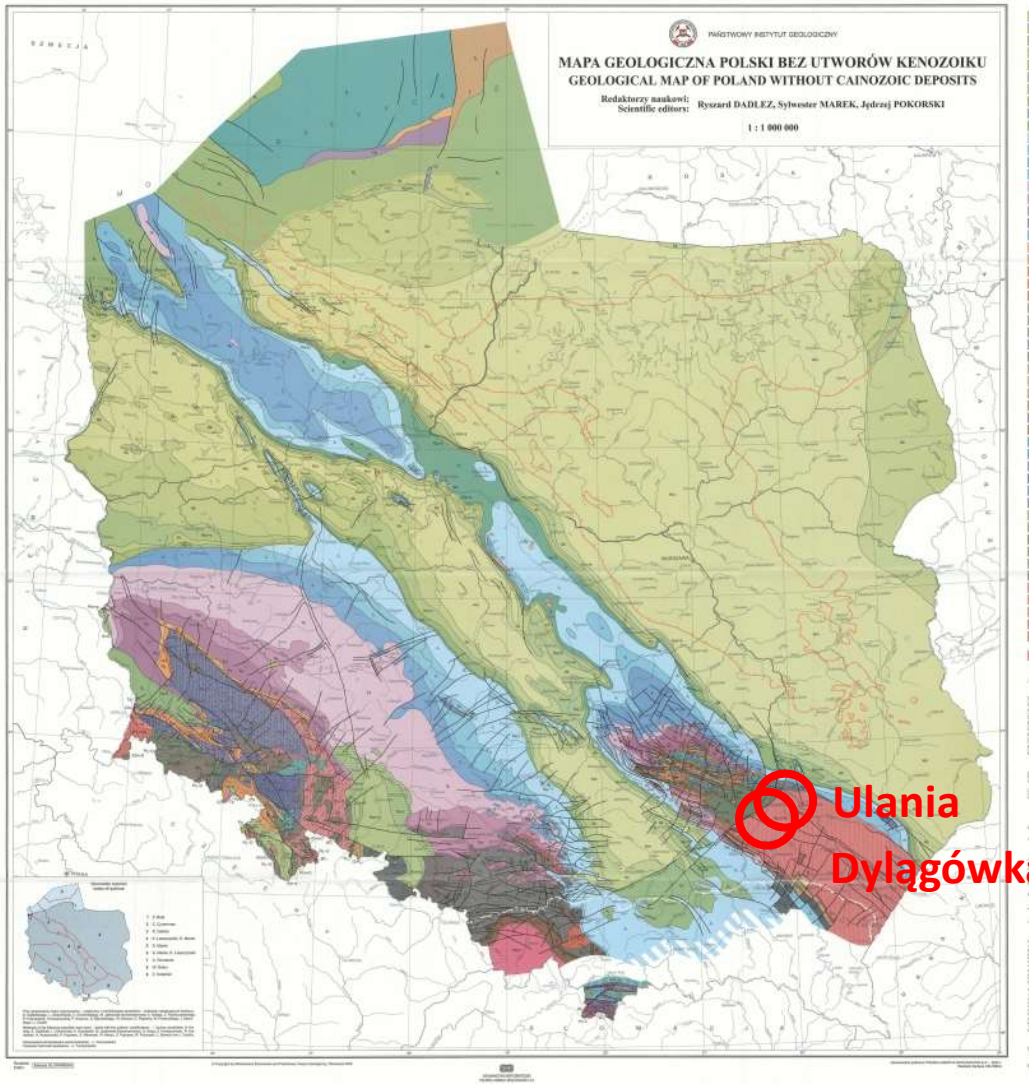
Natural zeolites:

- **clinoptilolite**
- **philipsite**
- **heulandite**
- **mordenite**
- **chabazite**
- **…**



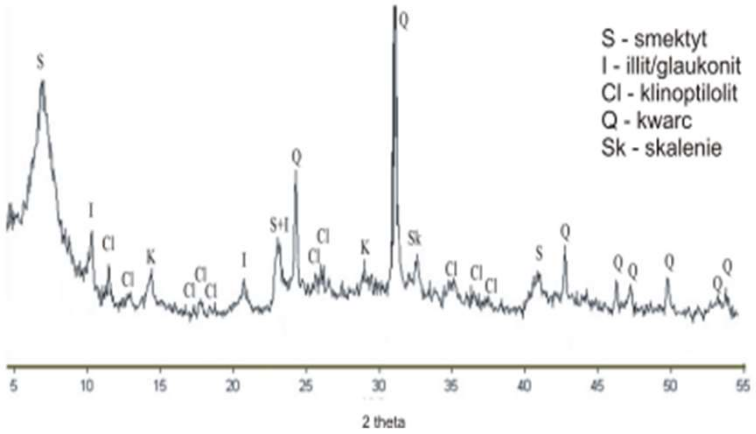


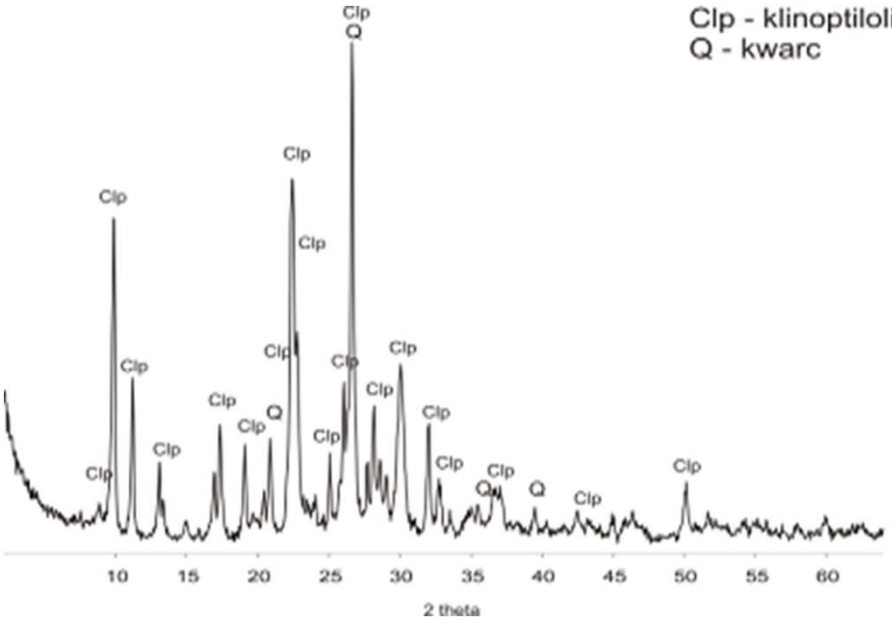
Polish zeolite

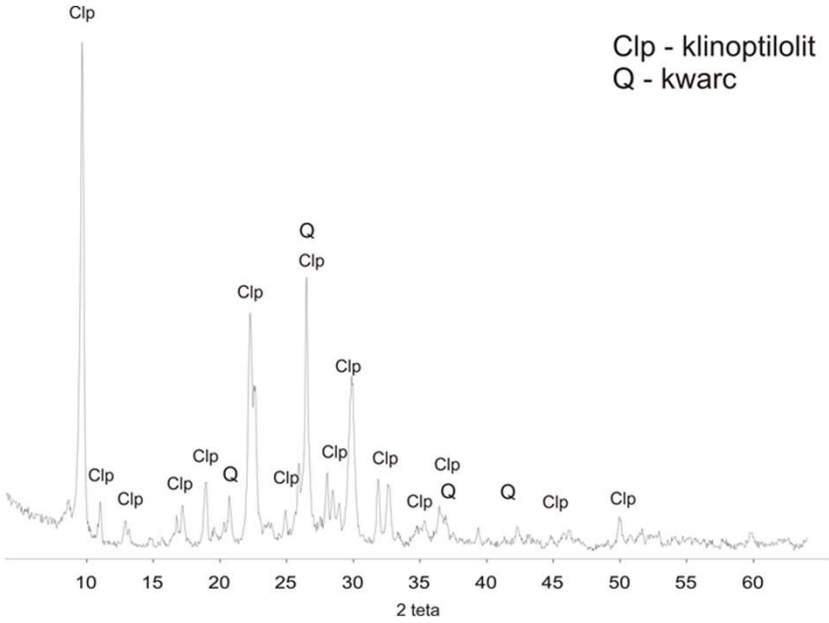


Dylągówka

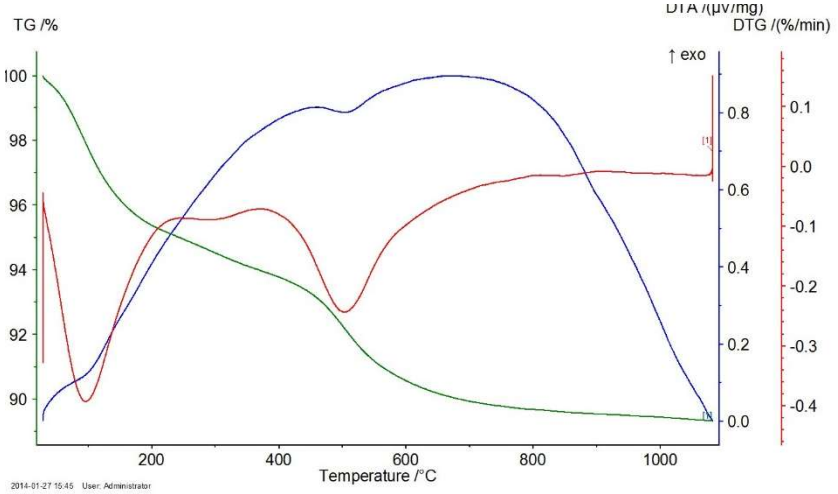
XRD diffraction pattern





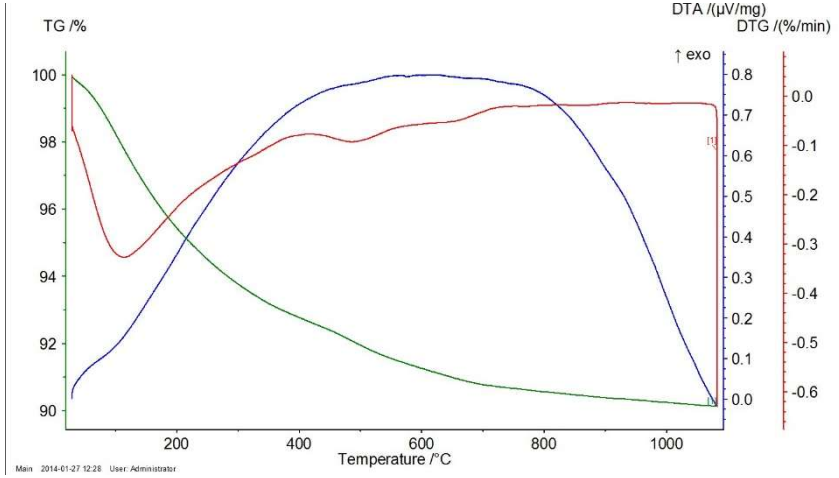


TGA

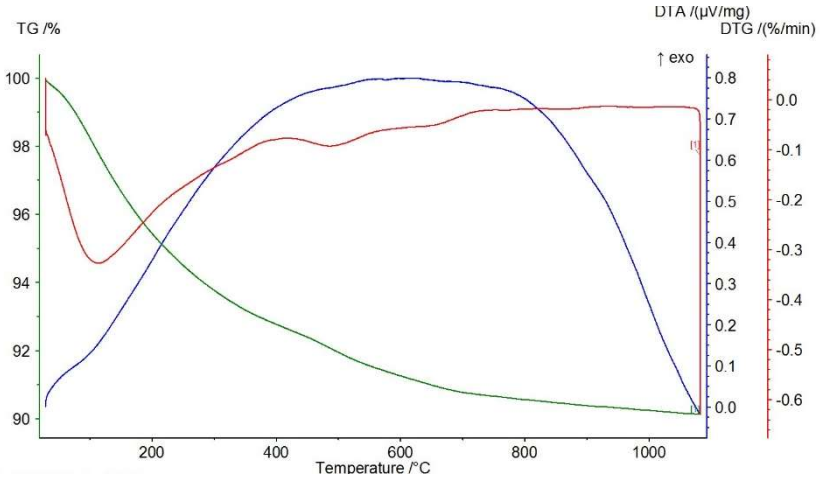


Clay of clinoptilolite

PL clinoptilolite



UA clinoptilolite

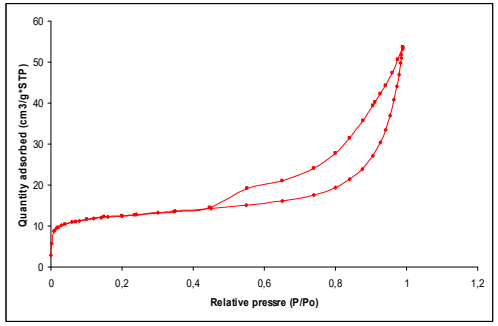


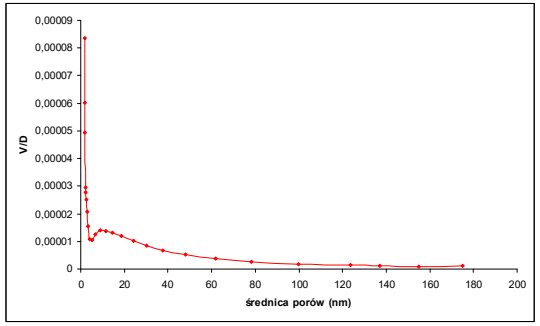
Cation exchange capacity

	CEC
Bentonite clay	**75 mval/100g**
Montorillonite-clinoptilolite clay	**22 mval/100g**
glaoconite	**17 mval/100g**
PL clinoptilolite	**35 mval/100g**
UA clinoptilolite	**142 mval/100g**

Textural analysis

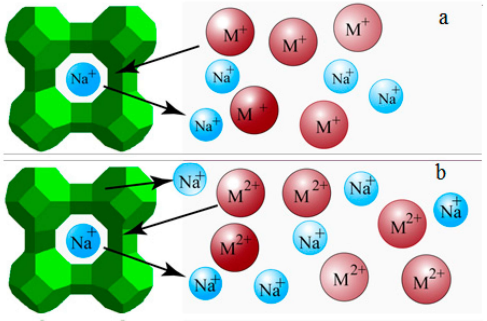
próbka	Mean pore diameter BJH 4V/nm [nm]	BET Surface area [m²/g]
Bentonite clay	15,5241	26,1751
Montomorillonite-clinoptilolite clay	12,4035	44,3360
glauconite	53,224	78,4443
PL clinoptilolite	15,8874	14,5543
UA clinoptilolite	24,2962	23,3268

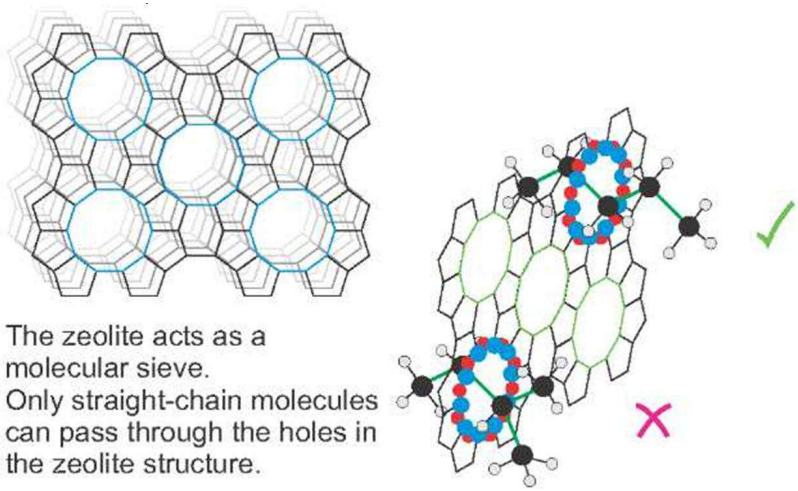




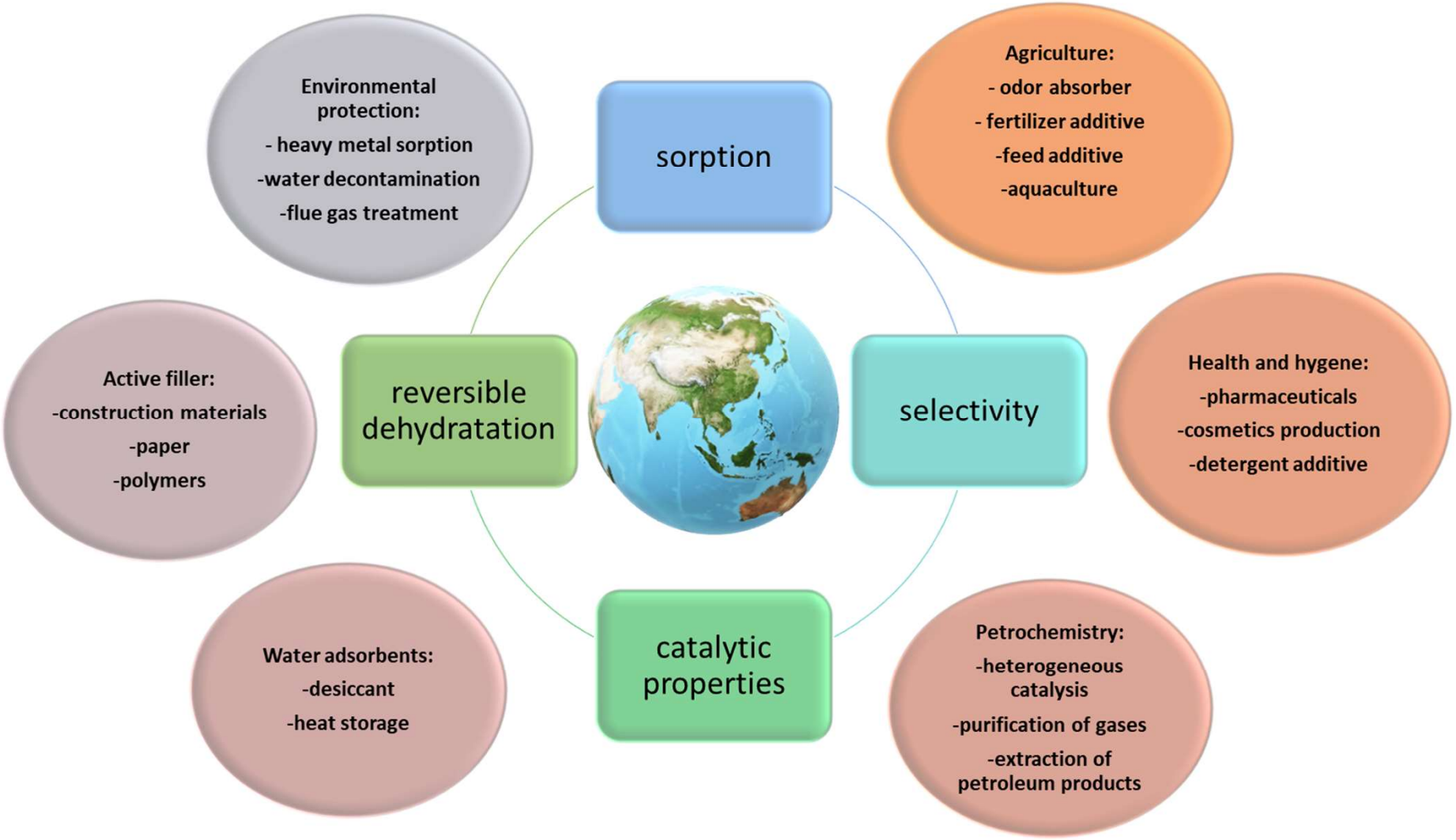
Zeolite properties

- Cation exchange
- Molecular sieves
- catalysts

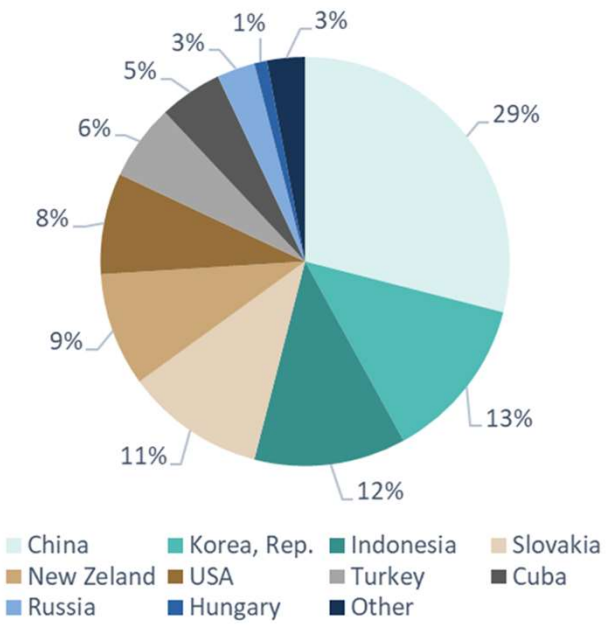




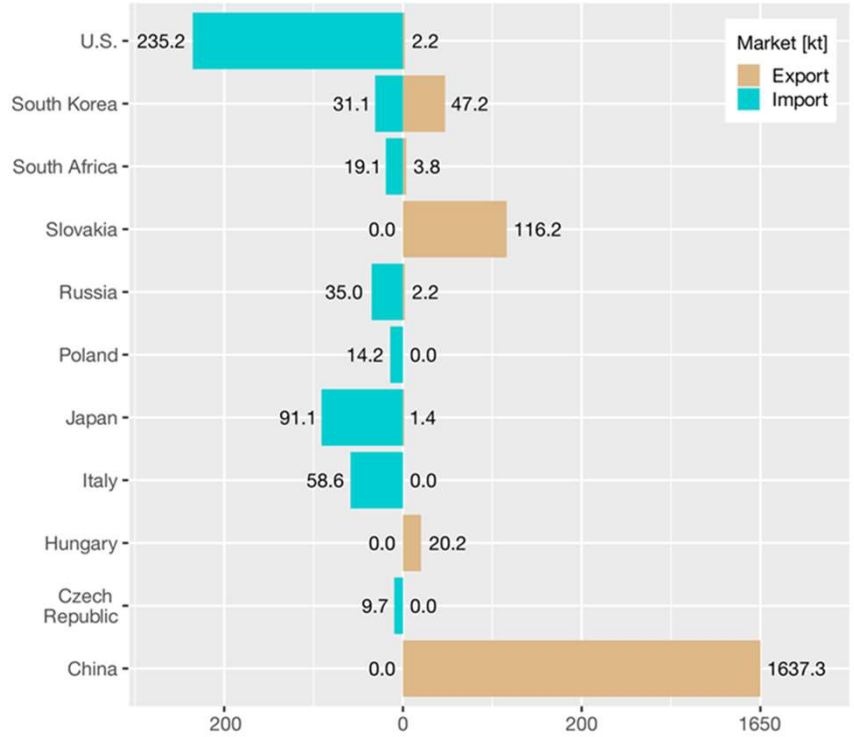
Applications



Zeolite merket in the world

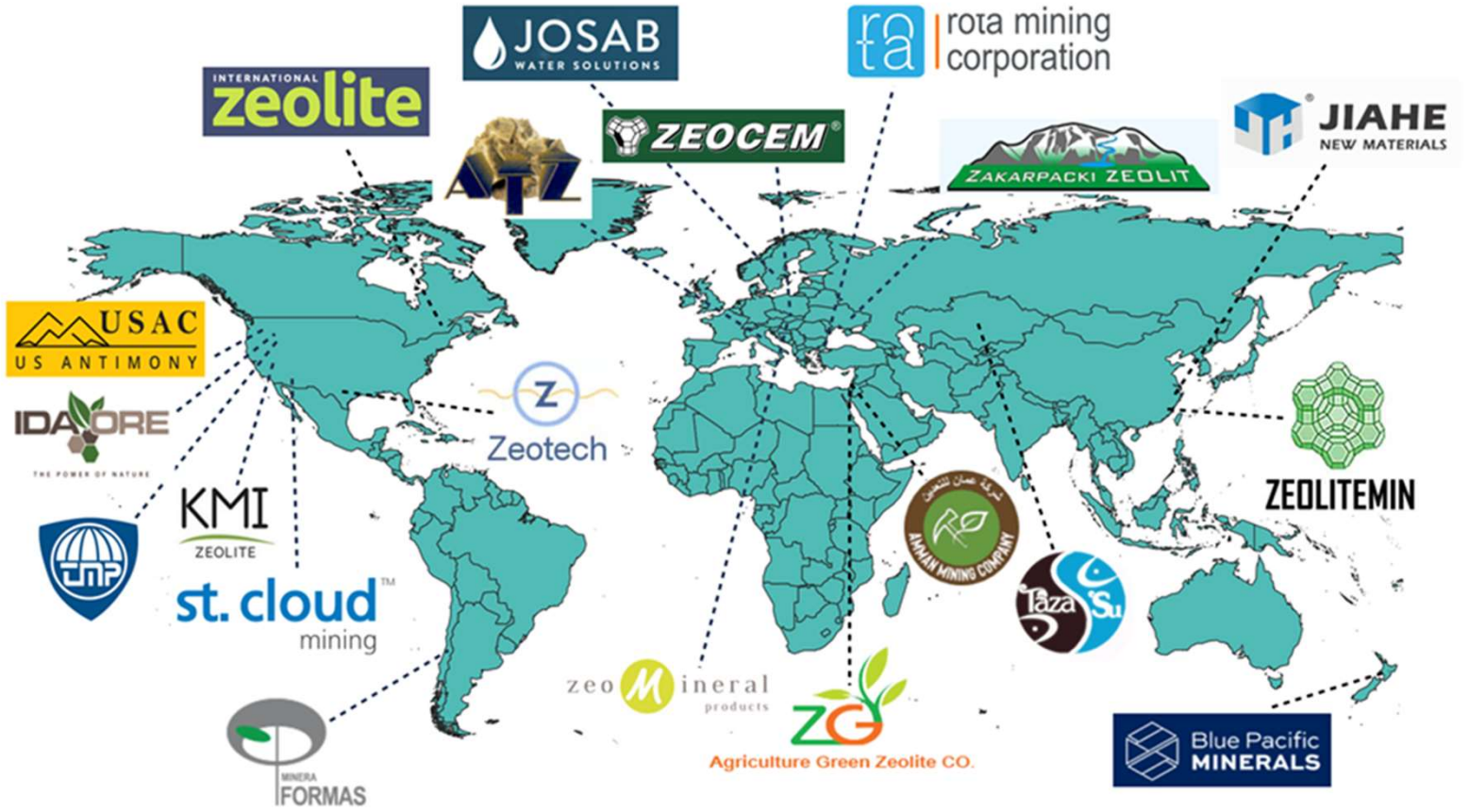


Estimated world mine production for 2020 (U.S. Geological Survey, 2022)



The volume of imports and exports of natural zeolite for selected countries in 2020

Main zeolite companies



Thank you for your attention

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