

## Nano-porous Crystals the zeolites

To understand natural crystals, to duplicate them, and to try to do better... the art of synthesis!

## The stone that boils: an amazing crystal

In 1756, **Cronstedt** made an astonishing discovery: while heating a sample of the mineral stilbite, it became covered in bubbles at around 150°C, as if the stone were boiling. Hence the name given to this mineral: "**zeolite**", from the Greek *zeo* (to boil) and *lithos* (stone).

## X-rays show the nano-porous structure of this crystal

In 1930, **Taylor** and **Pauling** used X-ray diffraction to study the first zeolite crystals and revealed that, at an atomic level, these minerals are made up of a nano-porous matrix. Stilbite is a sodium calcium aluminium silicate that can hydrate or dehydrate in a reversible manner, according to the temperature. **Water is trapped** within the cavities of the structure.

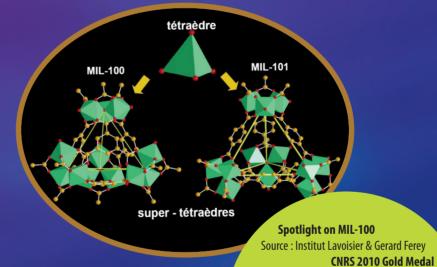
There are around 50 natural zeolites and more than 500 artificial zeolites have been synthesized ...

... by using this crystallographic approach, scientists were able to "visualize" the different atomic arrangements and cavities, enabling them to understand and then to create new zeolites.



Crystallographic studies allow us to see the structure of channels and to locate water in stilbite water: at -42°, the water enters the channels - to 168° the water leaves the stilbite. Heating causes a loss of water in the channels.

Source: IMN-Nantes



By combining organic molecules and inorganic bricks Gerard Ferey and his team at the Institut Lavoisier de Versailles could create new porous materials like MIL-100 and MIL-101 with giant cages, ten to one hundred times larger than those of natural zeolites, which can act as a reservoir of gas, molecules and

