"Rocking" on the Banks of the Columbia River

In Washington State a group of amateur mineralogists has discovered a new zeolite—a find with great commercial potential

EVERY WEEKEND HUNDREDS OF AMATEUR MINERALOGISTS head for the hills. Equipped with sledge hammers, gasoline-powered rock drills, and chisels, they carve, probe, and pick, seeking crystalline finds. Frequently their discoveries are merely pretty, satisfying only to the finders. Recently, however, a group of rock hounds in Washington State found a new zeolite that is intriguing university geologists—and even industry—because of its unique structure and potential commercial value.

The new zeolite is known by the euphonious appellation of boggsite. All zeolites (there are about 40) are what is known as microporous aluminosilicates: they are built from tetrahedral units of silicon or aluminum surrounded by four oxygens. There are both natural and synthetic zeolites, and in all of them the tetrahedral units are assembled into complex geometrical forms that include polyhedral cages and nets with labyrinth-like channels.

And it is precisely this complex geometry that endows zeolites with their primary commercial value. If the rings and channels are the right size, zeolites can do some remarkable chemical tricks. For example, by attaching specific catalytic molecules to a zeolite cage, chemists can induce the entire zeolite to act as a high-efficiency catalyst. Thus, in their most important commercial use, zeolite catalysts "crack" the distillation products of crude petroleum into gasoline. In fact, zeolite catalysts have replaced almost all others because they yield some 10 to 20% more gasoline—and at lower (energy saving) temperatures.

But the usefulness of known zeolites has been limited by the sizes of the rings and channels—and that's where the new find comes in. Some of the most useful zeolites boast internal structures based on rings with 10 or 12 members. The useful, but rare, zeolite known as faujasite has 12-unit rings; the widely used synthetic ZSM 5 has 10-unit rings. Boggsite, however, is the first zeolite to have a three-dimensional channel system with large pores and an internal structure that includes both 10- and 12-unit rings. This structure should allow boggsite to play a significant commercial role by trapping hydrocarbons of industrial interest. Moreover, boggsite is stable at the high temperatures at which petrochemical catalysis takes place.

Finding boggsite took the combination of perseverance and serendipity that characterizes many scientific discoveries. Perseverance because its godparents—18 amateurs, including physics professor Donald G. Howard of Portland State University and Snohomish, Washington, postal worker Rudi W. Tschernich—had to spend weekends for 3 to 4 months outside in a typical Pacific Northwest winter: steady rain and a temperature of 40 degrees. The focus of their work was a hole 6 to 8 feet in diameter and 5 feet deep, not far from the Columbia River near Goble, Washington.

Serendipity entered because the group wasn't looking for boggsite at all (since nobody knew it existed). They were looking for a recently discovered zeolite called tschernischite (another find of Tschernich's, made about 2 years ago, which hasn't aroused quite the excitement of boggsite). What they found, says physicist Howard, was some "little white balls that looked like another mineral, thomsonite, but the associations [with other minerals] were wrong [for it to be thomsonite]."

The mystery sample was sent to Eastern Washington State College in Cheney for preliminary x-ray analysis. Crystallographers there realized that a new type of mineral had been found. But what was the mineral's structure? Further physical, chemical, and optical studies were carried out by various collaborators. In the end, Joseph V. Smith and Joseph Pluth, geophysicists at the University of Chicago, deduced the atomic structure: the unique combination of 10- and 12-rings. Their results were presented at a meeting of the Geological Society of America last November.

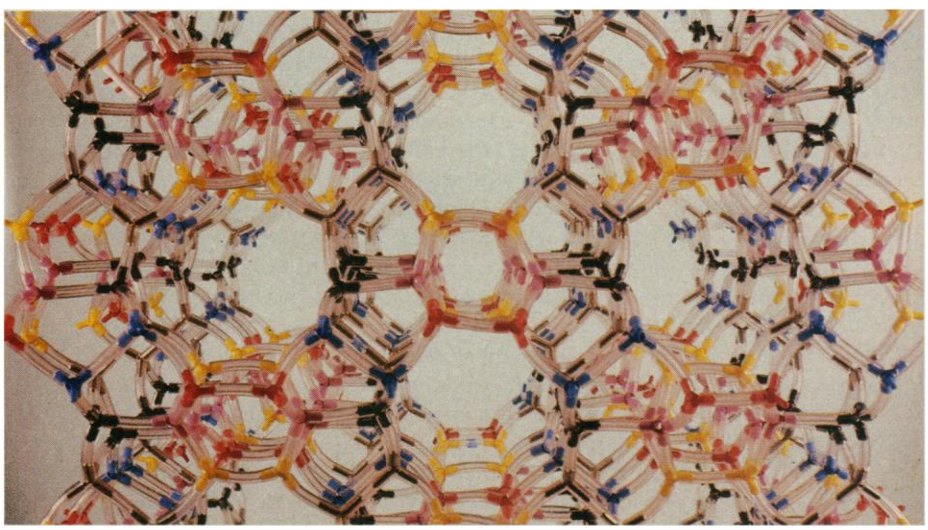
And that structure is what has whetted the appetite of industry. Chemist Edith Flanigan of UOP in Tarrytown, New York (a joint venture of Allied Signal and Union Carbide that provides materials for the petrochemical industry), is cautiously optimistic about the future of the new crystal. Though there probably isn't enough boggsite in nature to make it commercially viable, Flanigan figures that "if you could reproduce the physical and chemical properties [of boggsite] in the laboratory, you would have a substance of considerable commercial value." And that, she adds, is most likely "doable."

Meantime, the hunt goes on, as amateur rock hounds work the basalt boulders of the Columbia River Valley seeking the thrill of discovery. "Some are just there as part of a weekend sport, looking for pretty, glisteny crystals. But most of them are pretty knowledgeable. They come up with beautiful samples that we can do basic research on," says Frederick Mumpton of the State University of New York at Brockport.

And Smith of Chicago says: "It . . . shows that a lot of good science goes on in a quiet way by some very talented amateurs."

■ ANNE MOFFAT

Joseph Smith



Geology's newest "species." *Model of boggsite—a new zeolite with both 10- and 12-unit rings—made by Joseph Smith of the University of Chicago.*

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