ORIGINS OF LIFE

Joseph Moran

Origins explorer is seeking the chemistry that sparked life on Earth

Growing up in Canada as a performer and musician, Joseph Moran paid little mind to science. Later in college, though, when he decided to study medicine, he found himself enjoying the challenge of his organic chemistry classes. Hooked on chemical reactions and how they drive biological processes, he switched his major. "All of biology is organic chemistry," he says.

Now, an ocean away at the University of Strasbourg, Moran has been tackling one of his, and possibly chemistry's, biggest challenges yet: uncovering the chemistry at the dawn of life on Earth.

"It takes a lot of audacity to take on this problem as an assistant professor," says Moran's postdoctoral adviser, Michael Krische at the University of Texas, Austin.

Some origins-of-life researchers look for possible reaction pathways that might have, on early Earth, created the biomolecules that organisms use for energy. Their proposed pathways need to work without the help of cells or enzymes that

VITALS

- **CURRENT AFFILIATION:** University of Strasbourg
- **AGE:** 36
- **PH.D. ALMA MATER:** University of Ottawa
- **ROLE MODELS:** My senior colleagues Jean-Marie Lehn and Jean-Pierre Sauvage, who are both Nobel laureates. Jean-Marie for his work ethic and enthusiasm for science, which have not diminished even more than 30 years after winning the prize. And Jean-Pierre for his incredible humbleness despite all his accomplishments.
- **I'VE OVERCOME ADVERSITY IN THE LAB BY:** Adapting to the French academic system when starting up my lab. For example, the chemistry store on campus closes for much of August, so we have to stock up on solvents and chemicals well in advance.

wouldn't have yet existed in primordial times.

But those routes often start with reactive molecules, like hydrogen cyanide, and not carbon dioxide, like the pathways found in nature today. Many scientists think that carbon dioxide's relative lack of reactivity makes it an unlikely precursor for prebiotic chemistry. But Moran isn't convinced.

Instead, he and his team have found that metals and metal ions like iron and zinc can react with carbon dioxide and accomplish portions of two of the most ancient metabolic pathways: the reverse Krebs cycle and the acetyl-CoA pathway.

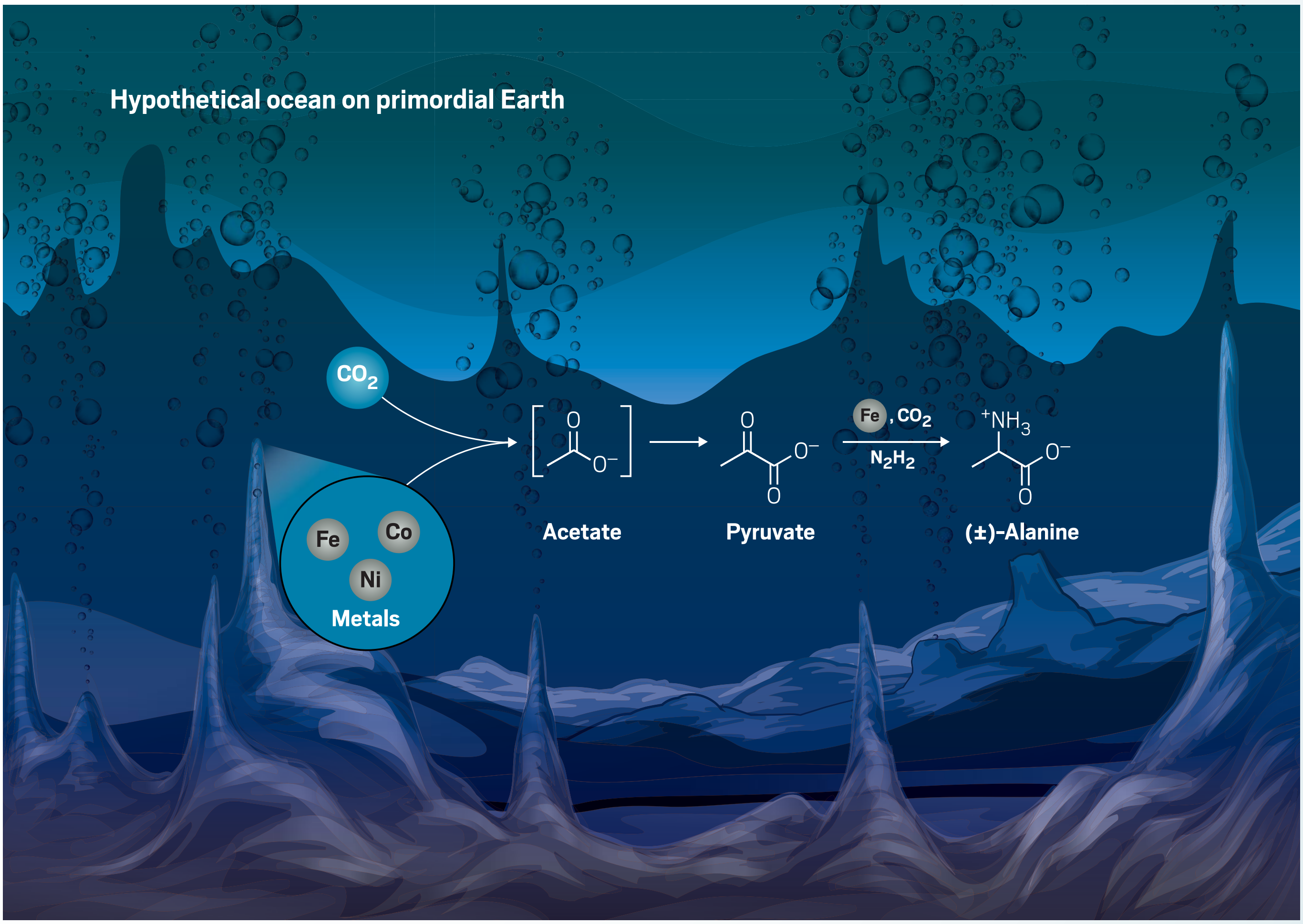
"His chemistry is so striking and simple," Krische says. "It's amazing that metals and metal ions can spontaneously produce half of a key pathway that normally takes 11 steps and 10 different enzymes to carry out," he says.

"How does complexity build itself?" Moran asks. "I think about this question all the time—in the shower, on vacation. It has really captured my imagination."

Pursuing this profound question has taught Moran that science is "just as creative as any art," though he still makes time for music by organizing karaoke nights right in the chemistry building. "I'm passionate about science now more than ever," he says.—TIEN NGUYEN

RESEARCH AT A GLANCE

Moran's lab has found that mixing metals in water under a pressurized atmosphere of carbon dioxide produces acetate and pyruvate, an intermediate and end product, respectively, of the acetyl-CoA metabolic pathway. Exposing pyruvate to the same conditions plus hydrazine gives the amino acid alanine. The researchers believe these reactions (shown) could be plausible prebiotic pathways to create the complex molecules necessary for life.



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