Rocks

Michael Vanden Berg came from Michigan to the University of Utah to study sedimentary stratigraphy. By 2005 he was working with Dave Tabet at the Utah Geological Survey, organizing core data, geophysical logs, and Fischer assays. Energy prices were on the loose, and interest in unconventional oil was rising.

Dave Tabet recognized that with the price of oil going up, there was most likely going to be this renewed interest in oil shale. And he's like basically put me in charge of this project and said, "Here you go." And I'm like, "First, what's oil shale?" I didn't even know what it was.

Vanden Berg found out soon enough. Geologists from around the world now come to him with questions about the Uinta Basin.

The Utah Geological, being a state survey, we're here to provide information on the geology of Utah to anybody who wants it−companies who are interested in development, people who own land out in the Uinta Basin, that might have this resource on their land.

The Uinta Basin is high desert, surrounded by mountains.

So the Uinta Basin formed as an intermountain structural basin during the Laramide Orogeny. So you had uplift of the Uinta Mountains. It was mainly the Uncompahgre Uplift to the south, created the basin in between, so the rivers kind of went towards this basin and created a lake. So the Green River Formation is the record of this lake that has been in the Uinta Basin for 5 million years.

The Uinta Basin has been on oil company maps ever since 1948 when Mike Dougan drilled his Ashley Valley No 1, ten miles southeast of Vernal. The basin is now punctured by no less than 8000 oil and gas wells. At least 20,000 more have been proposed.

So all the oil shale is in the upper Green River. Toward the end of the life of the lake. it became more of a restricted basin, and it had high salinity, similar to the Great Salt Lake now. So there was no outlet. The only outlet was evaporation, so you get higher salinities, and with those higher salinities, you get a lot of algae that can grow. At times you probably had a stratified lake. And so the bottom portion of the lake was anoxic, devoid of oxygen. So this algae that would die and fall through the water column would hit this anoxic zone. That's basically how the organic material got preserved, since it didn't decompose.

It turns out that geology of the Uinta Basin *is* rocket science. Its lakebed and shoreline stratigraphy is frighteningly complex and maddeningly variable.

It's one of the hardest things about studying the Green River; there's been a million people look at it, and they all give different names to different units, and all these units interfinger, and some *of 'em are facies changes, and some of 'em are lithologic changes, some of 'em are chronostratagraphic changes. People interchange time and sediment. So it's pretty complicated.*

Vanden Berg, more than most geologists, *has* made sense of the Uinta Basin.

These oil shale beds are actually what you had probably a higher lake level than you did kind of in the lower Green River. You can trace these oil shale beds, for the most part, all over the basin, like the Mahogany. There's the Mahogany Zone, and within the Mahogany Zone there's a Mahogany Bed, and you can trace that Mahogany Bed all over the basin. And that's a time when the lake was much higher, much deeper, and so all those shoreline faces are much further away.

Much of Michael Vanden Berg's work has involved conventional oil and gas geology within the Uinta Basin. But he has also studied unconventional energy sources.

The oil sand, the oil has been generated through geologic processes somewhere, and has migrated into a sandstone. And then that porous unit had an insufficient seal, or the seal was removed through erosion and the volatiles escaped, basically leaving behind the bitumen. That's how you get oil sands. Oil shale is simply a rock. There's no oil in this. This has organic material, kerogen. So the only way to make this into oil is to heat it. That's already been done there, through natural geologic processes, so a source rock was buried and subjected to heat and pressure. This is just simply organic material, or you could call it an immature source rock. So it's never been buried to the point, it's never been subjected to the pressure, to the temperature, to convert that organic material into hydrocarbon, oil and gas. So with oil shale, you actually have to do that artificially.

The US Geological Survey estimates that there are 1.32 trillion barrels of in-place oil shale resources within the Uinta Basin. But a barrel in the bush is not the same as a barrel in hand. In 2008, Vanden Berg tallied up oil shale resources in the Basin that might conceivably be harvested. He started by drawing maps that showed oil shale that contained fifteen GPT−or gallons per ton−too lean to make a profit. Then he focused on richer deposits−25 gallons per ton −and came up with number−147 billion barrels of oil−that ought to make a Saudi sheikh shriek. Finally he factored in nagging, economically significant details like overburden, seam thickness, and property considerations, and was left with a still-impressive figure−77 billion barrels there for the taking. But even this vertiginous number must be viewed in context.

You have these oil shales and tar sands which I see as truly unconventional because nobody—at least in the U.S.—is economically producing these things yet. Have you explored kind of the differences between Utah oil sands and Canadian oil sands? The differences are so pronounced that it's almost even hard to compare the two. The deposits in Utah are very small and isolated, compared to Athabasca.