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Rare Earth Elements Podcast - Brent and Julia

[00:00:34] **Bridget Scanlon:** I would like to welcome Brent Elliot and Julia Gale to the podcast. Brent and Julia work with me at the Bureau of Economic Geology, which is the State Geological Survey in Texas. And it's also an organized research unit within the University of Texas. Brent's research focuses on mineral resources, and Julia's has emphasized fracture systems in geology related to energy production.

Today we're going to focus on rare earth element potential in Texas and broaden it to other mineral resources in the state. So thank you both for joining me. I really appreciate it.

[00:01:18] **Brent Elliot:** Thank you for inviting us.

[00:01:21] **Julia Gale:** Sure. Happy to be here.

[00:01:23] **Bridget Scanlon:** The Bureau is extremely interested in evaluating the mineral resources in the State. And Julia, you have been leading an effort to develop a **report** on a current status and also developing a **web portal** to access data and visualize spatial variability on mineral resources. Would love if you could describe a little bit the report and what it will include and who the target audience is supposed to be.

[00:01:48] **Julia Gale:** Yes. Well, thanks Bridget This is part of the Bureau's **Texas imperative** where we're trying to look at some key resources and activities in the state. And ours is going to be called **Economic Mineral Resources of Texas**. And as Bridget mentioned, it's going to consist of two components. There's firstly a **Report of investigations**, which is a style of Bureau publication that's been done for many, many decades, and we will have that Report of investigations. And then in tandem with that, we're trying to develop an **online resource** for people so that they can view information and **maps** and other elements of interest surrounding mineral resources in Texas. But then in addition to that, the way that we're going to host it means that there will be an opportunity for people to be able to download **databases**. So, that will be a very interesting and useful aspect. And you mentioned the question of who our audience is, it really is pretty wide. We're interested in being able to communicate to all **stakeholders**.

So it goes from the subject matter specialists through government people, through academia and of course industry. And so it's really trying to cover everything, which of course is really a hard thing to do, but we're going to try to design it so that a general member of the public, for example, could go on the Bureau website and get some information.

They might not want to get to the point of downloading a database, but they would nevertheless benefit from being able to see the range of mineral resources across Texas and see some maps and general information.

So we're going to be hosting that on an **ARC GIS portal**, which will allow for us to do the things I mentioned. And the aim for our team, and it's a nice team, it's around about six to eight people that have really contributed consistently. We've brought other people in just to do very specific things. And we're trying to be ready by the **end of 2025** with the report. Of course, the online portal hopefully will be maintained on a periodic basis so that the material on there is up to date.

Coming to the scope of what we're doing, it's pretty large. It includes all the **mineral resources**, barring oil and gas, hydrogen and helium, because they're being covered elsewhere. I can, you know, really describe a little bit about the key chapters. The first will be an **introductory** chapter that gives some historical context and also some regulatory information.

The big meat chapter is **chapter two**, which is called the **Major Resources of Texas**, and that's two big subsections. The first one being **industrial minerals and materials**, and that has 12 subheaders in there. So it's everything, all the sand, gravel, dimension, stone, salt, sulfur, all kinds of things go in that industrial minerals grab bag.

And then we have the **critical minerals subheader**, which is a big one. That's got 19 subheaders currently, of which **rare earth elements** is one. Now, given that this is such a huge kind of range of things to write about, each topic is not covered extensively.

It's got links to information, to data sources, and to publications and then of course to some maps and things like that, that we would take from the online portal. We have additional chapters in there on **coal, lignite, and rare earth elements from coal waste**. And I know that Bridget and Brent are going to talk about that in much more detail. It's going to be in there, it's going to be a short segment because our overall RI is very long. We also cover **uranium, lithium**. And we have a section in there, **lithium from brines** and metals that are not already in the critical minerals group.

That's covering the data side of things, I suppose. And then we have some chapters that expand on the topics of **economic viability**, of resource development. Socio environmental, economic impacts of resource development. Then new **exploration, mining, and processing technologies**. And then another chapter on new opportunities, which can include, **heavy minerals from coastal sand**, that is a small chapter in there. And then also, different from all the other topics is development of a **workforce** that's going to do all the work needed to be able to make sure that we have the materials that we need.

So that's really the scope of it. It's quite large and we hope that people will read it and it will be available from the bureau bookstore for sure once it's published, and then there's the online.

[00:06:49] **Bridget Scanlon**: Right. Thank you so much Julia. I know that's a huge effort and I really appreciate all your work on this, and I was very impressed with the GIS portal and being able to see the distribution of many of these industrial minerals and others. What was surprising to me when I read some of it was the value of some of these products. I mean, **aggregates** in Texas, I can't remember the exact number, but I mean, it is huge.

[00:07:14] **Julia Gale**: Yes, and I'm not going to comment on numbers because I'll get my millions and billions mixed up, but certainly it's a very, very large number.

[00:07:23] **Bridget Scanlon**: Maybe Brent can chime in here.

[00:07:26] **Brent Elliot**: You can see over **10 billion in revenue** these days for aggregate materials.

[00:07:31] **Bridget Scanlon**: Yeah, I didn't realize that before I read that and then you mentioned **lithium**, and of course there's the huge interest in lithium these days and east Texas, and the **Smackover**. I think maybe Brent will talk about that in a little bit. Brent and I visited a proposed **nuclear plant in Abilene** last week.

That was very interesting, wasn't it, Brent?

[00:07:52] **Brent Elliot**: Yeah, that's the small modular reactor using **molten salt**, right? **Lithium, beryllium, zirconium fluoride salts**. They're pretty interesting project going on. They're in a small scale now. What **one megawatt** was it? They're planning on scaling that up, so it's going to be an impressive thing once the scale up happens.

[00:08:10] **Julia Gale**: We have a little section on that in the RI.

[00:08:13] **Bridget Scanlon**: Oh, great. Yeah, that's super. **Rusty Towel** gave us a tour and it was a very interesting. It's a **research reactor**. So they're not actually producing energy, it's about one megawatt scale. They're looking at the various issues and that technology was used in **Oak Ridge in the sixties**.

So it's not a new technology, but they're reviving it. And then the scale up, I think they mentioned, Brent was a **hundred megawatts in the Permian Basin**, and part of it to deal with the treating produced water. So, this is fascinating.

[00:08:44] **Brent Elliot**: It also had **medical applications for isotopes** they could produce, which I had no idea about until we took that tour. And so that combined with water treatment and then energy, now that's all aside from the energy possibilities. It's really, really impressive and innovative.

[00:08:59] **Bridget Scanlon**: Yeah. Very good job up there.

So Brent, you and I have been involved with the **Department of Energy Carbon, or Rare Earth Critical Mineral Project**, since about **2021**. Part of the Bureau led the **Gulf Coast program** and initially this program was focused on **coal and coal waste or ash from power plants**.

But then, in the middle of it, they broadened the scope to include other feedstocks for **rare earth elements**. Brent, maybe we can start with trying to describe the coal resources in the state.

[00:09:32] **Brent Elliot: Bob Reedy**, who was here at the Bureau, put out a publication that's gotten, a lot of attention, from scientists as well as just the public and press. Pretty impressive work that he did of assessing the **resources** in the Gulf Coast area, for our lignite material. Our lignite that we mine here in, the Gulf Coast area compared to bituminous coal or other kind of coal streams from around the US. We're pretty much focused on the **low grade material**. I think what was his account was about **83 gigatons of coal mapped in the upper a hundred feet** of the surface within the **Wilcox area** our primary formation that has coal in Texas, for example. It's all low maturity coal, **brown coal** material, or they call it dirty coal, even though you can still burn it. And we have certain kinds of power plants that are set up strictly to use that kind of coal material.

Kind of like the **San Miguel power plant** down south of San Antonio. But we estimated about, I think the assessment was over **30,000 drill holes**, right? that were assessed. 40% of the resources in Texas are from that material. But most of it's all **open pit mining**, strip mining. And that's been, occurring in Texas over well, where we up to **50 years** at least of mining here in Texas.

During the heyday, I guess back in the **nineties** or early nineties, we had about **29 different operations just here in Texas**, not including the rest of the Gulf Coast, and I think we're down to about **six or even less than six now**, as the decline of the coal industry in Texas has slowly happened.

Even more so happened in the last decade or so, as those mines start to run out of out of material and resources and start to close up operations, we've had a number of **power plants** that have shut down, sometimes incentivized by **solar power and wind power** and alternative energy sources that are coming online.

It's an interesting time for the coal industry here in Texas currently. But this is almost a revival now of assessing all of the **waste material**. But then now we have the waste material as a resource, as we've shown in the publications that you have put out with the concentrations of potential rare earth materials, critical minerals.

[00:11:31] **Bridget Scanlon**: I think the big push on coal happened in the **seventies** during the energy crisis. Then a lot of coal power plants were built and mines became very active. Then as you said, **peaking**, but then in the recent decade, a lot of these coal power plants are closing down and the mines closing down also.

North American coal company still has a number of mines. They have in addition to those in Texas, they've also got **Five Forks in Louisiana and Red Hills in Mississippi**. We are collaborating with them to evaluate the rare earth element potential in these coals. The one thing is the **raw coal**.

The lignite in the Gulf Coast is similar to the lignite in the **Williston Basin in North Dakota**. So these immature brown coal, the rare earths are associated with the **organics**. And can be readily **extractable**. Brent, we've been making a career out of trying to evaluate the rare earth element distribution in these coals.

We find some **hotspots**, but a lot of them are just similar to crustal levels, but hotspot in **Gibbons Creek**. To put it in context the **average crustal abundance** of rare earth elements- and that includes Lanthanides and Yttrium- is about **180 parts per million**.

The Gibbons Creek mine has up to **2,800 parts per million**, but that's just a localized hotspot. And the Gibbons Creek mine is **closed**. And many of the others are similar to the crustal levels. But we have very few samples, Brent, so we have to keep going. We've only got about **120 samples** and I think the **Williston Basin**, they have **2,500 samples** because North Dakota's very supportive.

So **San Miguel**, they're still, that's low to moderate levels. What do you think Brent is the potential of developing rare elements from the coal mines in the Gulf Coast and Texas specifically, but also, maybe Louisiana, Mississippi?

[00:13:25] **Brent Elliot: Gibbons Creek**, those values, **2,800 ppm**, that's significantly high. The only shame is that mine is **closed** and it's been **reclaimed**. It's gone through the reclamation process, through the regulatory agencies, and it's almost completely released all the way down to the last acre.

I'm not sure if the new **landowner** would be keen on the idea of reopening the mine and starting a whole new process, a new open pit mine like it was in the past. I think they're probably more interested in pasture land and leasing that land now for other purposes. But you never know, the economics could show it to be most useful or beneficial to be mining again.

Otherwise we have a lot of **ash material** or lignite material with low values. Even low values can be a resource if there's enough of it. I would think that if you have ash material or other material that's being mined elsewhere in the United States, like **Williston Basin or Powder River Basin**, if you have seams that have elevated concentrations or look to be a higher priority for rare earth element operations or production, they're more likely that those would be targeted first.

It's just **economics**.

[00:14:25] **Bridget Scanlon**: We've got a huge resource of coal, **83 gigatons**, as you mentioned. They could potentially develop rare elements in the Gibbons Creek mine. But I think there's a lot of interest in **non-thermal uses of coal**.

Using the **carbon** for **activated carbon** or **soil amendments**, **humic acid**, and other purposes, besides burning the coal. There is a mine in Louisiana that feeds into an activated carbon plant there. I think that's also potential right?

[00:14:54] **Brent Elliot**: Yeah, I mean there's a lot of different uses. If we have other sources of energy that may be cleaner or at least perceived as being a cleaner option. Then I think well it's an advantage to doing that. Then turning these coal mines or coal resources into something else that's also a benefit rather than having to burn it.

Of course if you do have to burn it and you get ash material, they're always looking for ways to use the **ash** into the **cement** industry or into some other form. A **trash to treasure or a waste to resource** mechanism. Because the last thing we want to do is bury it somewhere when we could actually use it for something.

[00:15:24] **Bridget Scanlon**: Right, right. We are very fortunate that we have a strong collaboration, with the **North Dakota** and **Nolan Theaker** in North Dakota. And so they have done a lot of research in **extraction of rare earth elements from the raw coal** itself and find that the **extractability is 60 to 80%**, very easy to extract with the **environmentally benign, weak acids**.

That would not cause problems. So if they do decide to develop, a North American is interested in evaluating the potential from their active mines now. That's a possibility. In contrast the extractability of the REEs from other coals, like the **Appalachian** coals, and **Illinois** basins is much lower and requires much **stronger acid**.

That's going to be more complicated. But the **Powder River Basin** also those **coals** may be more difficult to extract. So you mentioned coal ash in power plants and Bob Reedy did an analysis of coal ash throughout the US and found that looking at the linkage between the **coal source** and the **coal ash** where it was produced. And I guess, figured out maybe about **52 gigatons of coal** consumed in the US from the 1950s to 2021.

And about **10% of it** average becomes **ash**. That's about **5.3 gigatons of coal ash** throughout the US but that varies a lot from about **6% coal ash** in sub bituminous coals, like Appalachia to **14% in the lignite** in the Gulf Coast, in North Dakota. I think he found that maybe **70% of the coal ash** hadn't been sold or used on site.

It's potentially accessible and has been disposed of in **ponds and landfills**. Maybe you can describe that a little bit Brent, and, the previous studies by **Taggart** and others had looked at the rare element concentrations in the coal ash from those sources.

[00:17:12] **Brent Elliot**: That ash has to go somewhere if you're not using it for some other purpose, like in the **cement** industry or road-based material. And I've heard there's a number of potential uses for the burn material. One interesting thing though is that those **concentrations**, I remember like high **Appalachian Coal** being about **585 ppm**, whereas **Powder River Basin** around **330 ppm**, towards in Yttrium. That's very similar to a lot of the conventional **Round Top** out in **West Texas**. Conventional rare earth elements, resource of **igneous** rock. You'd have to basically mine it and crush it and acid leach it and be able to get out pretty much the same kind of PPM per ton of material as you would with some of this coal material or ash material, it's already being produced, right?

And already in a state that you can be readily **leachable** compared to those hard rock sources. So it just makes sense to take on these **waste materials** and get the work done out of that rather than going to a conventional source, typically a low grade ore. We consider that a low grade for a hard rock material.

You think about **lithium** and in **pegmatite**, for example, would be **8%**. That's a huge number for a commodity coming out of a grade of ore material. Taking advantage of the ash material in these coal resources, if it's trapped in the **organics** or in the actual coal, and it's already being mined.

We're taking advantage of the **workforce** that's already there. The **mine's** already there and material's already being produced. It's a no brainer as far as taking advantage of it since it's already been served up.

[00:18:32] **Bridget Scanlon**: Right, right. The coal ash from the Appalachian coals and Illinois coals the extractability is fairly low, maybe **30%** with the **strong acid**. But the **Powder River Basin coal**, which has just been distributed throughout the US, the **extractability** is much higher. Maybe **70%** because it has high **calcium**.

That's an advantage. And Department of Energy **NETL** lab have been doing a lot of work about extracting rare earth elements from coal ash, from the Powder river basin. Some of the power plants in Texas, they have burned a variety of different coals, Appalachian and Powder River Basin coals, in addition to the **lignite** at the **mine mouth plants**.

Bob Reedy estimated that about **0.3 gigatons of coal ash** was produced from **lignite** in the **Gulf Coast** over a long time. And as you said, when you burn coal, you concentrate the **Rare Earths**. So on average what he found is that the rare earths were about **four times more concentrated** in the coal ash than in the **raw coal**. But then the **extractability** is much lower and so they kind of balance each other out. The extractability from the coal ash is much lower than the raw coal. If we estimate the rare elements, the **oxides**, the value of those is about estimated to be a **billion dollars**. The value from the heavy, the **permanent magnets** is almost **\$0.9 billion**. You are correct that we should take advantage of this, hopefully. Then in all other regions a lot of these **power plants** are near **rivers** for cooling and near **shallow groundwater**. Some may be some **contaminants** leaching into the water.

There may be an interest in moving that ash to a safer resource for environmental purposes.

What do you about the **reclamation** status and offsetting contamination Brent?

[00:20:17] **Brent Elliot**: It is a **liability** certainly, and it's always been a liability. It takes **monitoring** for decades part of a mine's **reclamation** plan. They burn that coal. The coal may go on back on site or maybe go offsite, but it's into an **impoundment** somewhere or surface impoundment, that it has to be monitored because you have to monitor **groundwater** contamination or potential for groundwater contamination.

Hopefully those **pits** are mined and then restoring that ash material over time. Just as a waste material that has to be monitored, because of the potential for contamination. We've had a number of cases where those impoundments have **flooding** events and then those impoundments break,

and then you get **ash washed** across the surface somewhere. And then we have **land surface** contamination as well as, potential **groundwater** contamination.

It's a risk and a liability to have that material just sitting there. So it just makes sense to use it for something. And if we can get something good out of like rare earth elements or critical minerals, and alleviate that potential for risk from those impoundments that makes total sense.

[00:21:10] **Bridget Scanlon**: The production of **Rare Earths** could **offset** part of the **remediation costs** also.

[00:21:15] **Brent Elliot**: Yeah, definitely.

[00:21:16] **Bridget Scanlon**: When we look at the **economics** of developing rare earth elements from coal or coal ash, I think the technical economic analysis underscores the need to develop **co-products**.

In Texas, maybe average price of Lignite is about, **\$20 a ton**. And the value of the **rare earth elements is maybe three or \$4 a ton of coal**. Certainly important to develop additional co-products. What are your thoughts about that Brent?

[00:21:44] **Brent Elliot**: Well, I already know with the production of **activated carbon** from that **ADA location in Louisiana**. We have that potential **humic acid** and amendments, like you said. There's any kind of **synthetic carbon materials** that could come out for **water filtration** systems and using that activated carbon, for example.

Those are all co-products that can be done in some of these coal mines. But then, you know, a lot of the ash material also has potential for things like **iron and titanium** and major elements besides the elements of rare elements that could come out of it. There's a lot of potential from that material because it's already in a **concentrated** form once the burning of the coal happens. And so there's a number of companies that are looking at new technologies. **Chlorination**, for example, of ash material in order to remove those metals.

And that again, offsets the cost of the coal. Or it is **additional revenue stream** in addition to like rare earth elements, critical elements. Scandium, for example. Things like this that may be inside the coal material. If we can get as much of these different mineral commodities out of that material as possible, then it benefits everybody.

[00:22:40] **Bridget Scanlon**: And another possible co-product is a **synthetic graphite**. I think there's a group in **Wyoming** that are looking at developing other carbon materials. Any thoughts on that relative to mining **natural graphite**?

[00:22:53] **Brent Elliot**: It's simply it's more **energy intensive**. It is more **expensive**. You can take either graphite, mine graphite material, and make graphite other kinds of, products from the graphite there is a shortage of graphite. Graphite's on the critical mineral list, and so it may be used for more specific things other than the coal product.

I haven't really thought about using the coal products as long as we have graphite mines and graphite availability, but I guess it could be a co-product if you wanted to take advantage of it.

[00:23:20] **Bridget Scanlon**: Partway through the Department of Energy project, they expanded the feed stocks that we could consider. Brent, maybe you could talk about a little bit about, some of these other **potential feedstocks**, particularly the **red mud from aluminum processing** in the Gulf Coast. Maybe could provide some background on that.

[00:23:39] **Brent Elliot**: We have a number of places that are across the Gulf Coast and two of them here in Texas at **Copano and Point Comfort** along the coast that were part of the **alumina processing** of **bauxite** material. And then the waste product that comes off of that is a **red mud**. Right? So we typically just call them red mud. It is **bauxite residue**. And through the **Bayer process** we get that material and it gets **stockpiled** because it typically has a **high alkalinity** Has a pH around **11 to 13, so it's caustic**. It's not great material when it gets pumped out as a sludge onto these giant **impoundments**.

And we have a number of these locations along the coast, and most of that material's coming from either **Jamaica** or **Brazil** or, some other location. We process it here in the United States and then have to host that waste material over time.

So it'd be great if we could find a use for it and through our efforts, through the CORE-CM project, the **Carbon Ore Rare Earth Critical Mineral Project** with DOE funding. I've been able to analyze a number of those samples from here in Texas as well as in, **Louisiana at Gramercy and Burnside**. Those have pretty high levels of rare earth elements at around **2000 PPM** at Gramercy and over at **Copano**. About an order of magnitude less than that around 200 or so PPM over at **Point Comfort** location.

But **2000 ppm** that's pretty significant. As far as the concentration of rare earth elements inside a waste material that's just sitting there in the impoundment. That could be used for something useful. And I think that group, **ElementUSA** was operating the Gramercy location they've moved their offices here to **Austin** and I think you had Chris Young on your podcast before. I guess listeners can go back and listen to that podcast and about all the interesting things that they're doing and innovation they're doing here at their **Cedar Park location** just north of Austin. They can have other core products like **Iron** out of that waste material as well as finding ways to remove things like the **rare earths, yttrium, and scandium**, things like this in the red muds.

[00:25:33] **Bridget Scanlon**: It seems to me the most promising source of rare earths that I have come across.

[00:25:38] **Brent Elliot**: From a waste material that has been sitting there for a very long time and would sit there for a very long time unless you do something to take advantage of it.

[00:25:46] **Bridget Scanlon**: The **Copano site** and many of these coastal sites are near the coast or they're within a **couple of meters near sea level**. So **environmentally** very vulnerable. And so, managing these waste resources will be very important from an environmental standpoint.

And you mentioned both Copano and Gramercy from Louisiana. If we estimate that the rare earths in the **Crustal rare earth levels** is about **200 parts per million**. So **Copano** median value of about **2000 parts per million**. 10 times crustal levels and then **Gramercy** is about **4,000 ppm** but we have limited samples from Gramercy, and I hope you are going to rectify that in the near future.

Talking to some people about **extracting** REES from these products. They say they can get up to **80% extractability**. The rare earth elements. All of them are **high**, including scandium, which is probably the most valuable rare earth. So a lot of interest in scandium for defense and stuff.

So really, really promising. But there are other sources also in Texas, Brent.

[00:26:48] **Brent Elliot**: Beyond the kind of the red mud as a potential source for rare earth elements or critical minerals that could be easily accessible on there. It is a waste material that's sitting there impounded that we could take advantage of. The **heavy mineral sands** is another opportunity.

There have a number of **sand mines** that have gone through some struggles as of late. The sand is your **industrial sand industry** for **fracking**. It has its ups and downs and depending on where you are in the country, is where you source your sand material from.

So, like the **Northern White Sands** used to be a pretty heavy provider for that frack sand material down here to Texas. And then we also had the **central Texas sand district** with industrial sand mines that were there. Were feeding into that and maybe a little lower quality, but very similar in age and quality of material.

We had a whole lot of mines that opened up in **West Texas** to facilitate the fracking operations in the **Permian Basin**. In more recent years that's driven the cost down for a lot of that material to the point where a lot of these mines in central Texas, for example, can't compete.

Maybe even the ones the northern White Sands and coming from **Minnesota** and in **Illinois**, and **Wisconsin**, for example, can't compete with some of that low cost material they're getting out there in West Texas. Those industries, at least here in Texas and central Texas, are looking for any kind of opportunity they can do to find revenue from their sand resource.

Heavy sands, things like **zircon, monazite, and xenotime** is a whole lot of different materials. The titanium oxides for example, are all within these heavy sands as a fraction of that mine material is a waste product because not really using it for fracking. The heavy sands in central Texas are one potential source of earth elements. And it takes up about one to **2% of the total ton of material** that's there in the sand resource. About **4% of that heavy, sands, is rare earth elements**.

[00:28:32] **Bridget Scanlon**: And that's from limited sampling done, right?

[00:28:35] **Brent Elliot**: Limited sampling, but all indicators showed it's fairly **homogenous**, at least within these **Cambrian division sands** that are on the **basement** rocks. So I wouldn't say that would be the case all industrial sands across the state, but the ones that are basically in close association with the per Cambrian basement rocks that that have

[00:28:52] **Bridget Scanlon**: The **Lano Uplift area**.

[00:28:54] **Brent Elliot**: Yes. Yeah. Or places that are very similar to these Cambrian division sands. That they have probably more potential than others. And we've done some preliminary studies and done some estimates on how many **mines** we could possibly open in high potential areas there in central Texas.

And it's a potential a lot of material that would be already being mined. And you just have to be basically **mechanically filtered or sorted**. Then you'd have a feed stock of relatively high potential. We're talking **40,000 ppm or 4% material**.

That's pretty significant, if you can spend the money to mechanically separate it.

[00:29:25] **Bridget Scanlon**: And Julia you were involved in research on **hydraulic fracturing** in the past, and I know from my work that over time they increased how much frack sand they were putting down hole to using cheaper sands rather than the Wisconsin sands or the high quality sands for fracturing the rock.

And then they were able to get it locally from the **Monaghan sands** and other things that are not heavy mineral sands.

[00:29:49] **Brent Elliot**: There are **sand dunes** that are out there that are relatively young.

[00:29:52] **Julia Gale**: Yeah. The other angle is the activity in the different basins. One of the reasons why all the sands from the **Brady area** was so popular was because they were able to feed the Fort Worth basin activity in the **Barnett Shale**. That's still going, but it's not as active. It's still active, but there's not the requirement that there was.

Now, the big volume is out in the **Permian Basin**, as Brent mentioned. When you've got materials like **sand**, the amount of distance that you have to transport, it is a big driver of where you're going to get the sand from.

[00:30:26] **Bridget Scanlon**: I think there was a tradeoff between the quality of the sand and how much sand they put down hole. So they put a lot more **proppant** over time and more water for fracturing over time. Then they plateaued at a certain point, but they increased that because they figured out that they could use low quality sands if they use more of it.

[00:30:46] **Julia Gale**: Yes, the art of proppant placement and actually knowing where it's gone and the hydraulic fracture system is far from set shall we say. There are many factors, but the big driver is the Permian Basin activity.

[00:31:02] **Bridget Scanlon**: Brent, you've been involved in the **lithium** work also, in **East Texas**. And that extends from **Arkansas**. Maybe you can describe that a little bit and the potential for that.

[00:31:13] **Brent Elliot**: We put out a paper, **JP Nicot and Roxanne Darvari**, on the oil field brine chemistry characterization across the state. As part of their work here at the Bureau, we put a paper back in, I think the early part of **2024**, I believe it was. That did an assessment or a characterization of all of the geothermal **oilfield brines** across the state. From the **Permian Basin, the Eagleford, the Haynesville, the Barnett, the Anadarko Basin**, and all the different basins across the state to show, the different variations.

So some of that work combined with the **USGS brine database data** that has been around for a long time and they keep updating it with better data. It shows that **Smackover** has potential for **lithium** production. Everyone's familiar with of the lithium over in Arkansas.

That trend, goes all the way down into **northeast Texas** and bends down towards the **south**, into eastern Texas. **Standard lithium** has drilled wells and they've put out some notices. They had over **800 pp m of lithium** within some of their brines that they drilled.

You look at like **South American brines** that have about **1300 ppm** that's for oilfield brines that are in constant production every day. Those are pretty significant numbers for the volumes, and already in a concentrated form coming from a natural formation.

[00:32:25] **Bridget Scanlon**: And I know there's interest in **lithium** in the **produced water** from the **Permian**, and they produce lots and lots of water in the Permian Basin, but the concentrations are pretty low. Average concentration, maybe **20, 30 parts per million**, but if they improve the **extraction** technology or they're going to be treating that produced water anyway for other purposes, they may be able to extract the lithium from that also.

[00:32:49] **Brent Elliot**: Right, and so in economic geology, you can have high grade resource and you produce very little of it. Kinda like the **Smackover volumes**. Very low volume, but high concentration or you could go after something that's a **low concentration and high volume**. Certainly Permian, how many billions of, gallons are produced over time.

It's a lot of volume of water that they would to take out of the ground with those low concentrations. But if **extracting technology** is there, and they have an easy way of actually producing a **lithium carbonate or lithium chloride** or some other lithium product out of that. Certainly if it is **economical**, they'll do it.

[00:33:23] **Bridget Scanlon**: So one of the advantages of all of this development in the Gulf Coast and in Texas, is that the **coastal location** is very advantageous. There's a lot of infrastructure to support rare earth element development and critical minerals and other mineral resources. You mentioned ElementUSA and I think also **Lynas** is developing a processing plant near the coast.

Maybe you can describe the processing, because processing is as critical as finding the source of rare earth elements in the US. Being able to process it also is extremely important because currently a lot of it is processed in **China** and we don't want to just find the resource and then send it to China to process.

[00:34:02] **Brent Elliot**: Certainly we our major bottleneck within the United States, I think is, We've worked out enough of kind of **extractive technology**, so I think people have demonstrated they can extract it. Maybe not as economical, we have more restrictions and more regulatory aspects to deal with in say, China or somebody else. They can do it cheaper on the extraction side around the globe. We do have a lot of **coasts** here in Texas, and have the ability to bring in materials or use domestic supply materials, and then we can import or export. And so having **Lynas** have that DoD contract, whatever, a couple hundred million dollars from DoD to help them build that facility for rare earth element extraction along the Texas coast at **Sea Drift** is a big deal.

So they expect to be able to produce a lot more material once they're already in operation. They have other facilities around the globe already, so they know what they're doing and they've shown that they can do it in other locations.

Having it here in Texas should be a real **game changer** for moving materials here to Texas to process, and then move them other locations. We have a number of companies, that, you know, startups like ElementUSA here in Austin. There's **Maverick Bio Metals** in San Antonio, they're looking at **enzymes** using biology to extract metals and other things in the subsurface or from materials from feedstocks. There's a lot of different groups that are really starting to do the production side of things.

ElementUSA is a **middleman**, they're a **concentrator**, they'll take that feedstock, they'll turn it into a concentrate, and they'll take it to someplace like Lynas, for example. And then have a product either

as an **oxide or a carbonate or a phosphate** or whatever. The end product is that the industry can use to make microelectronics or medical equipment or whatever from that point.

[00:35:33] **Bridget Scanlon**: Right. When you were talking about the aluminum processing in the Gulf Coast in Copano and these other sites that was importing bauxite from **Jamaica** and some from Brazil and stuff. The coastal location is extremely advantageous. I think Lynas maybe might import, feedstock from **Australia** with some of their current production there to start off.

[00:35:53] **Brent Elliot**: Yeah, from Australia, and then I think they had locations in the **Caribbean** that also have potential as a feedstock that can come in.

[00:36:00] **Bridget Scanlon**: So, a lot of things happening and, we had the **Critical Minerals workshop** with Marek Locmelis at the department, the Jackson School of Geosciences, and also with the Bureau, had the critical mineral conference recently that he hosted with **NSF** in Austin. Do you guys have any comments on that?

I found it extremely interesting and learned a lot, and it was great to see the variety of topics being discussed.

[00:36:23] **Brent Elliot**: I think it's one opportunity for most people. A lot of times you go to a conference and it's focused on just resources or just extraction or just policy, and this one actually then brought in, all the speakers were from different areas. So you had **industry**, you had **policy**, and **regulatory** framework discussions.

You had **resource**, people are actually doing the mining, people who are actually doing the **processing**. So if you get everybody who's in the supply chain together in the same room to have those discussions where everybody can see their everybody else's pressure points are, I think a lot of the kind of solutions can be reached a lot faster than if you just had a silo of content or a silo of a certain focus, like a lot of conferences are focused on.

So I think we need more of these unsiloed, full spectrum workshops. We call it a workshop and I say a conference, right? That way we could actually come to some result or some kind of conclusion and make the connections with the people you need to make connections with at these kind of critical mineral workshops.

[00:37:18] **Bridget Scanlon**: And how did you enjoy it Julia?

[00:37:20] **Julia Gale**: Well, following on from what Brent said, I would look at it from another angle, which is the spectrum of **expertise** that was there in terms of experience. So you had everyone from a very senior person from USGS, who's been doing this kind of evaluation for decades to the very newest students.

Coming back to the **workforce** development, these kinds of workshops are going to be very important to bring students on, to expose them to the range of topics that have to be tackled. And sometimes we're getting students who have mixed expertise; so somebody might have expertise in **geology and policy**.

And whilst that might seem strange bedfellows in this particular space, it's actually something that might lead them to be able to develop a career that was quite meaningful. I enjoyed it a lot from different perspectives, but in the Jackson School we've started the hiring process, because for a very long time economic mineral resources were a smaller effort.

Brent and Rich Kyle and people like that were soldiering on there by themselves. But now we're starting to look at hiring more people and developing a portfolio of skill sets. And then I think that's probably going to be true across UT, because there's all the people in engineering and in policy that could also contribute.

[00:38:48] **Bridget Scanlon**: **Marek and Daniel Alessi** focusing on **lithium** and all of the lab equipment and everything, and then having Element USA down the road, they would be hosting a lot of the people, various people to test out their extraction processes and everything.

I'm really excited about the report of investigations, Julia, and I think that would be a huge plus. And also the web portal is just incredible.

Do you guys have any last minute comments?

[00:39:17] **Julia Gale:** Yeah, I think, I come from mostly working with oil and gas companies on geological problems, and the model that we found that's very successful in academia is to have input from industry. Often in terms of consortia. So we have multiple companies buying into a, particular project or topic area.

And then we also sometimes have bespoke overheaded projects. But the industry/ academia partnership is going to be fundamental in terms of research. And I see we have a lot of experience of doing that in oil and gas at the Bureau. I think that some of those models can be taken forward to allow that kind of partnership to flourish.

[00:40:00] **Bridget Scanlon:** Also **Brent** worked previously at the Railroad Commission, so you have a good understanding of the **regulatory** side of things. So that's very helpful also.

[00:40:10] **Brent Elliot:** It's kind of the Wild West for minerals right now here in Texas. Coal and radium is regulated by the railroad commission. But a lot of the other commodities, metals, mining and where even lithium from brines is all new. We're making the rules up as we go now, it's becoming more and more important as we're recognizing that those resources are here and there's a lot of potential from these waste materials.

The regulatory side of it, the policy side of it, those are all vitally important right now in the scheme of things in order to make things happen at a rapid pace. We need it yesterday, we don't need 10 years from now, like the typical timeframe for regulating a mine, right?

But if we have waste resources that we could get out now and get it produced, that's vital to our domestic security for critical minerals.

[00:40:51] **Bridget Scanlon:** Well, thank you both for participating in this podcast. And I will include material on the website with links to resources and papers and to the workshop. So the listeners can access all of that. Looking forward to more discussions. Thanks a lot.

[00:41:06] **Brent Elliot:** Thank you.