Evaluation of Critical Mineral Potential from Coal and Coal Ash in the U.S.Gulf Coast

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Basic Questions:

1. Should we access REEs and CMs from coal or from coal ash?
2. How do REE levels in lignites in Gulf Coast compare with those from N Dakota?
3. What is path forward?

Key Takeaways

- Gulf Coast
  - **Lignite resources** (90 m): **84 gigatons (Gt)** (30,000 boreholes)
  - Coal production: **~2% of resource**, ~1.9 Gt from 32 mines (1972 – 2021), 5 active
  - Coal burned in **73 power plants (~7.3 Gt;** 25% GC, 35% PRB, 21% Appal.)
  - **Coal ash** averages **~10% of coal burned** (~0.7 Gt coal ash; ~17% of US coal ash prod. [4 Gt]); 66% potentially accessible in landfills and ponds

  Total REEs coal basis = **180 ppm** (mean), **100 ppm** (median) based on **84** coal samples (mostly USGS archived)
  - **Total REEs in coal ash** = **4 × those in coal**

- N Dakota
  - **Total REEs coal** basis = **260 ppm** (mean), **170 ppm** (median) based on **1074** samples

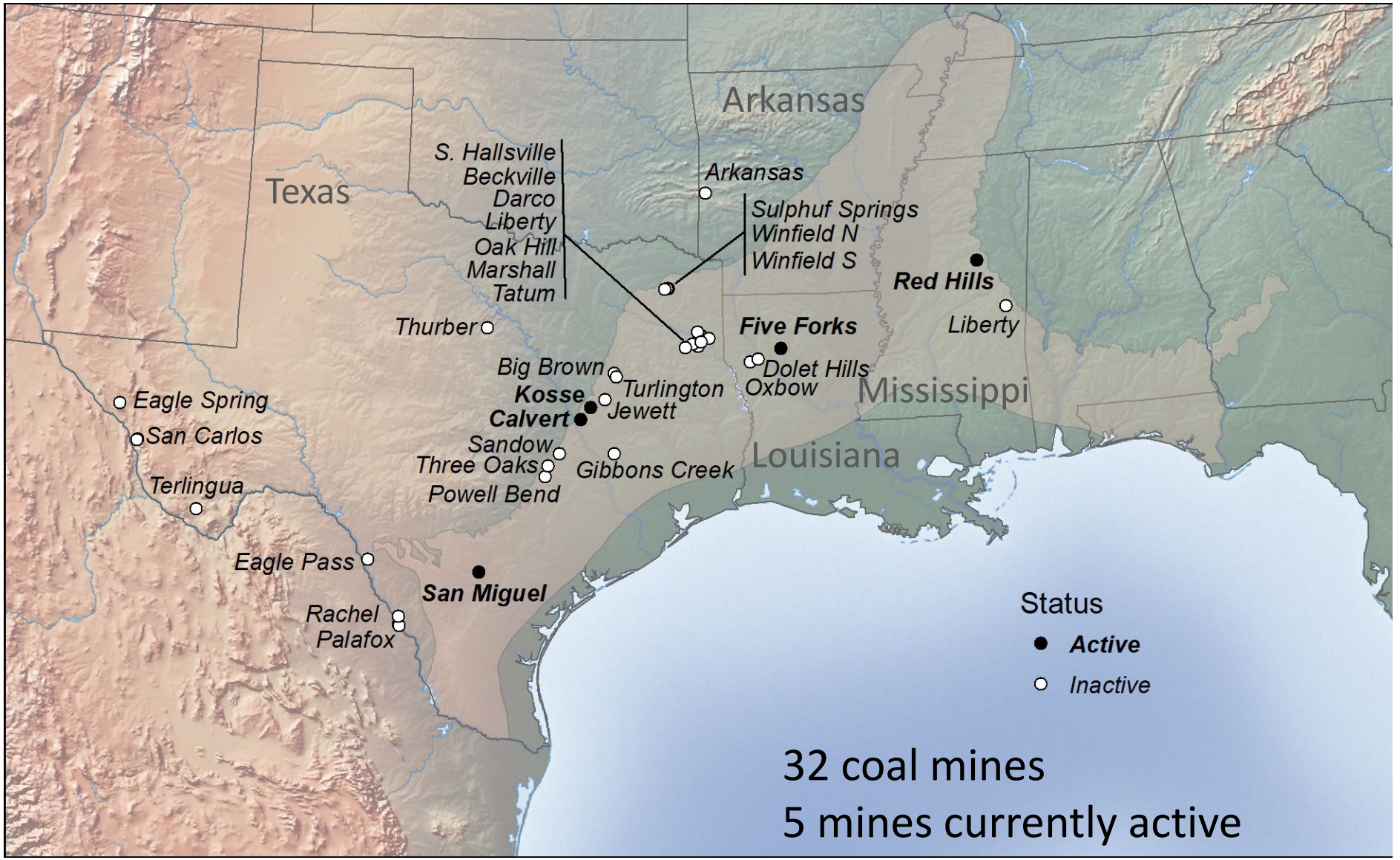
- **Extractability** from **coal** is high (**80 – 90%);** from **ash** is **low** ~ 30%

Reedy et al., Intl. J. Coal Sci & Technol, 2024

Tradeoffs Coal vs Ash

Coal	Ash
• Mining, infrastructure, processing, and reclamation • Large resource (84 Gt) • REE conc.: low – mod. • Extractability from lignites: high • Five mines remain open, most closed	• Ash deposits in landfills and ponds, vary over time • Smaller resource (~ 0.5 Gt) • REE conc.: higher than in coal (4–10×) • Extractability from ash: low • Status of landfills, reclaimed

Coal Mines in the Gulf Coast

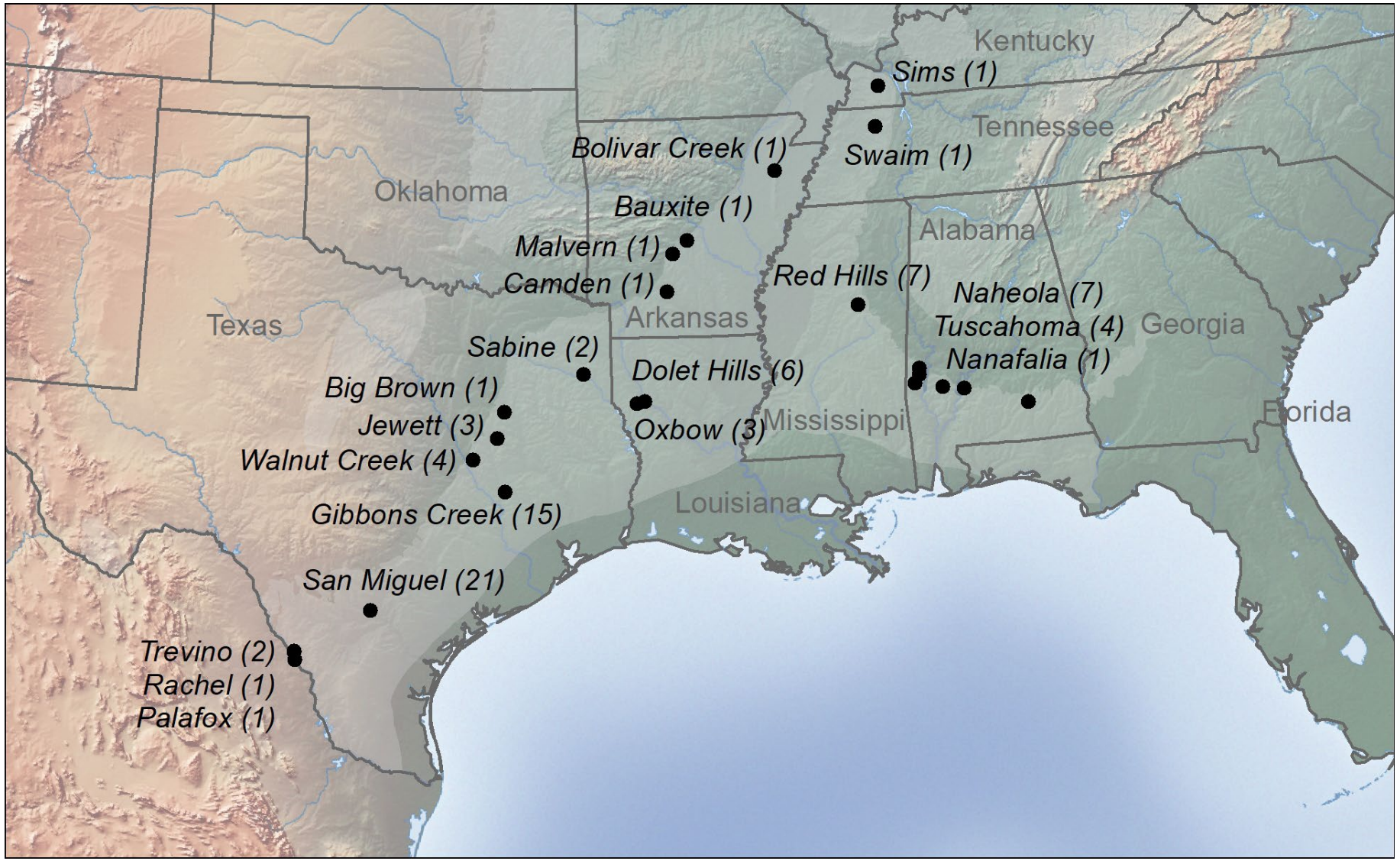


Surface mines extracting coal in upper 100 m.

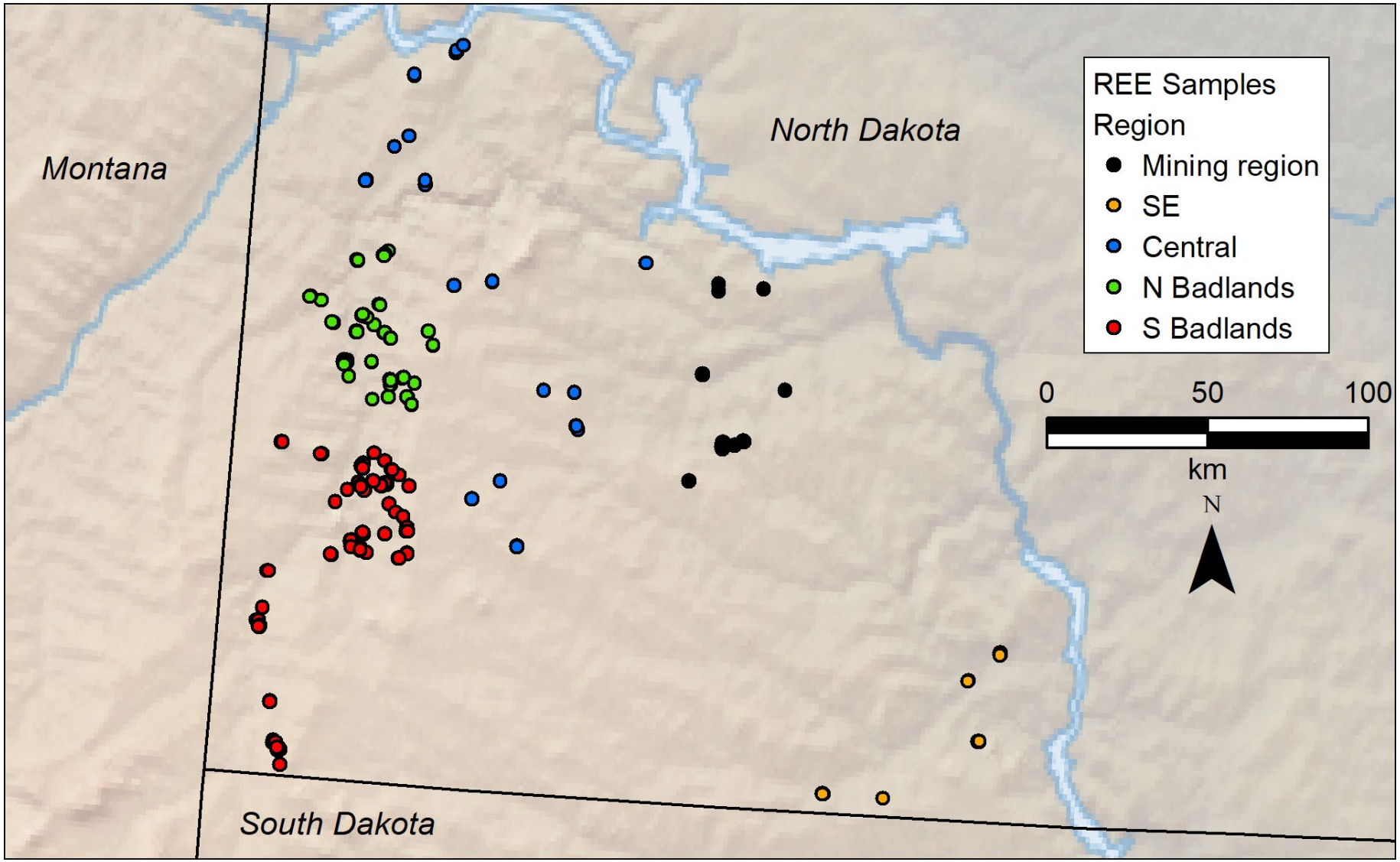
Methods

- Coal thickness mapped from 2011 USGS Gulf Coast Coal Assessment report (TX, LA, Ark, MS, and AL) plus supplemental data from states with a total of ~**31,180** boreholes
- Developed regional maps of total coal thickness across the basin in top 90 m
- Analyzed 84 representative USGS archived coal samples including ~20 new samples from across the basin for critical minerals and REE levels
- Compared REE levels in Gulf Coast lignites with those from N Dakota
- Assessing new sources of REEs in Gulf Coast

Gulf Coast: Coal Sample Locations (84 samples, 21 sites)

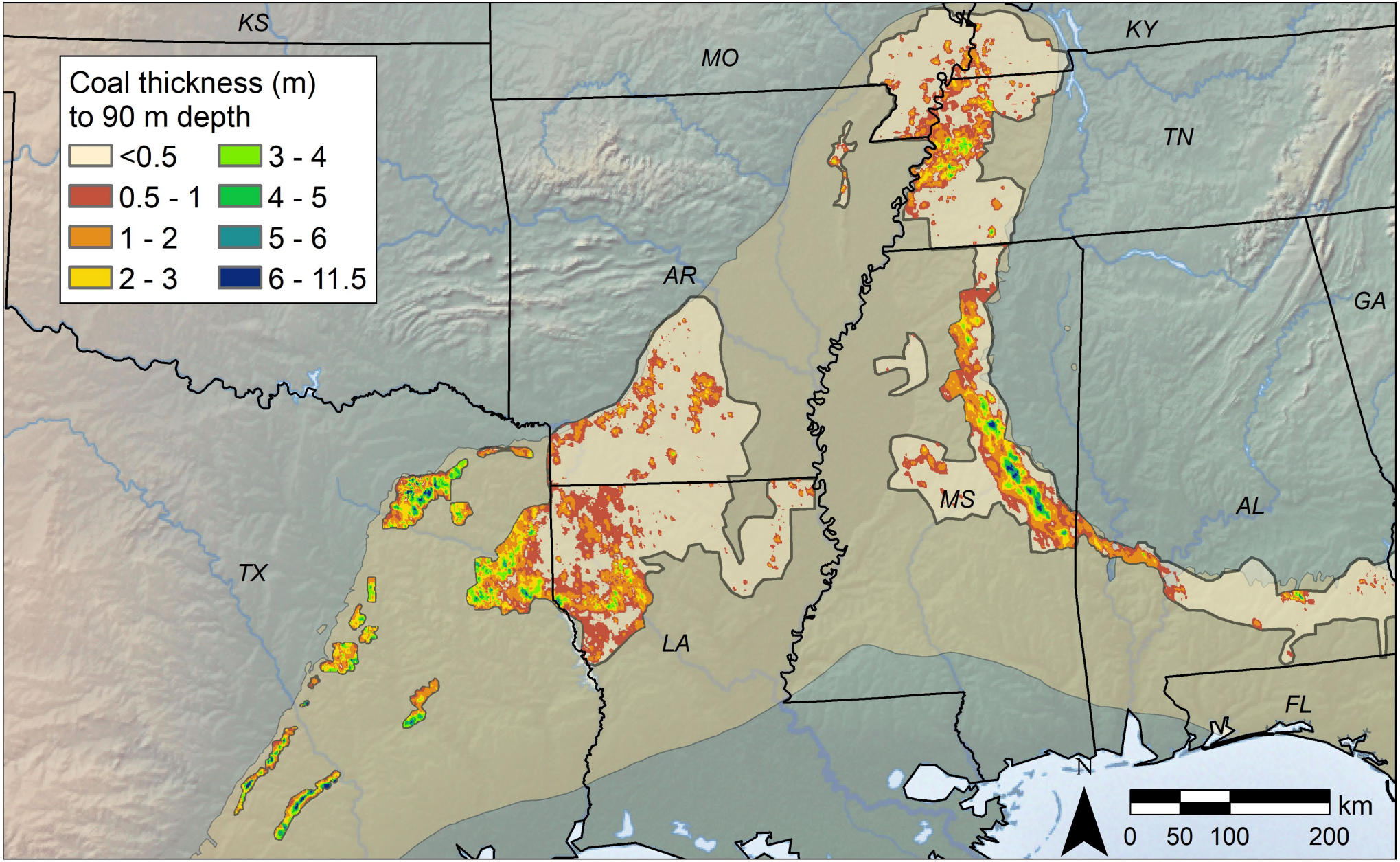


N Dakota: Coal Sample Locations (1076 samples)

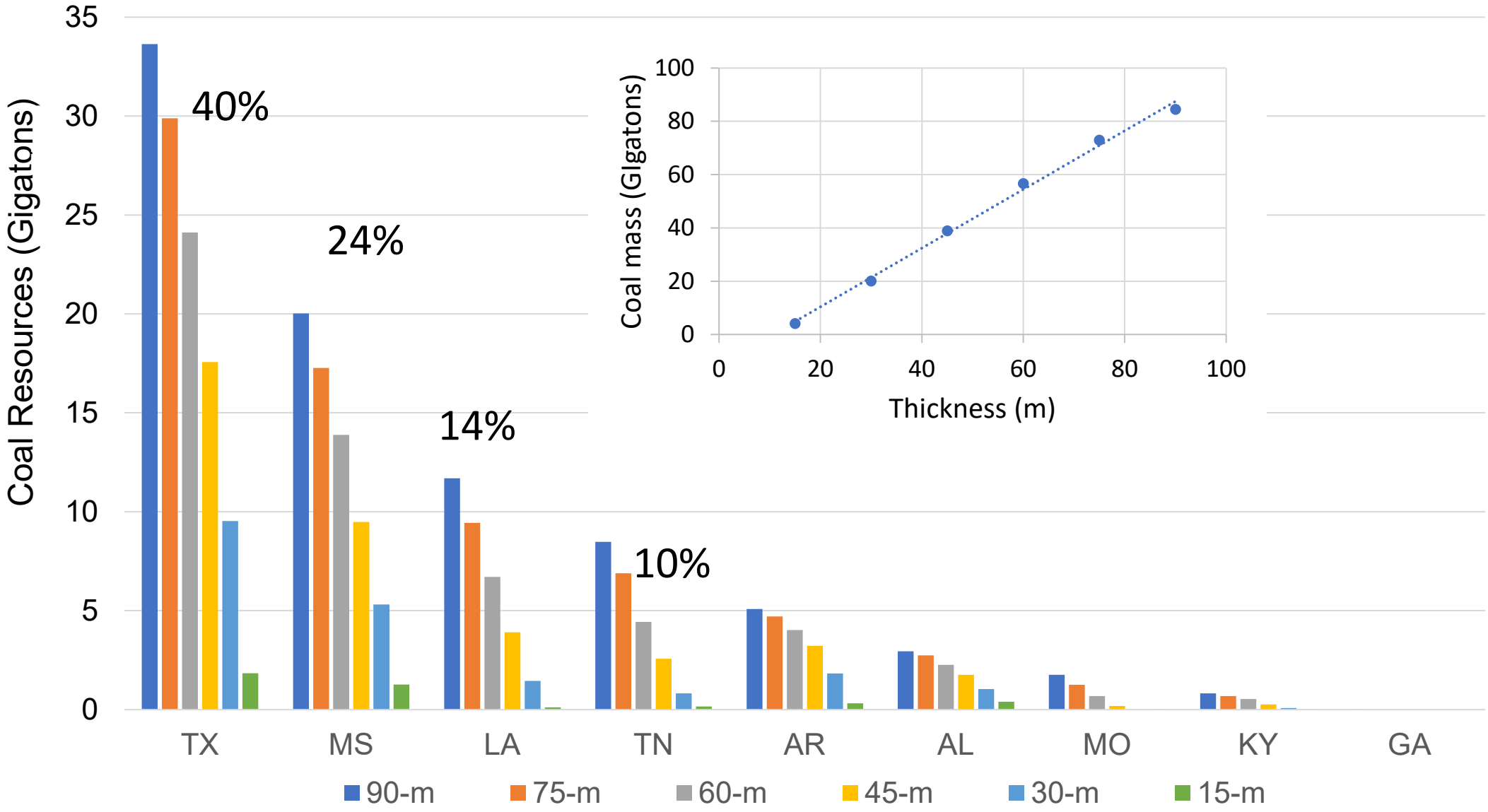


RESULTS

Regional Coal Thickness Distribution

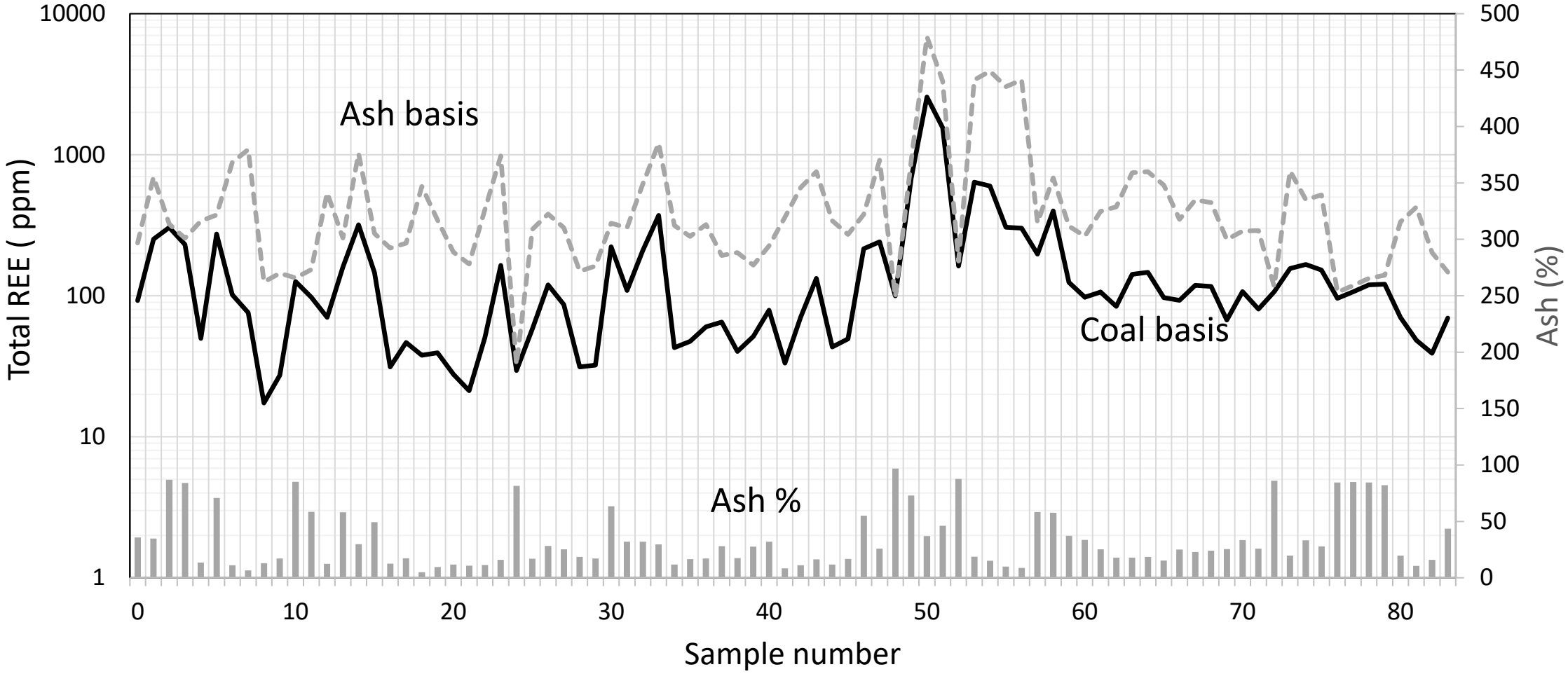


Coal Resources

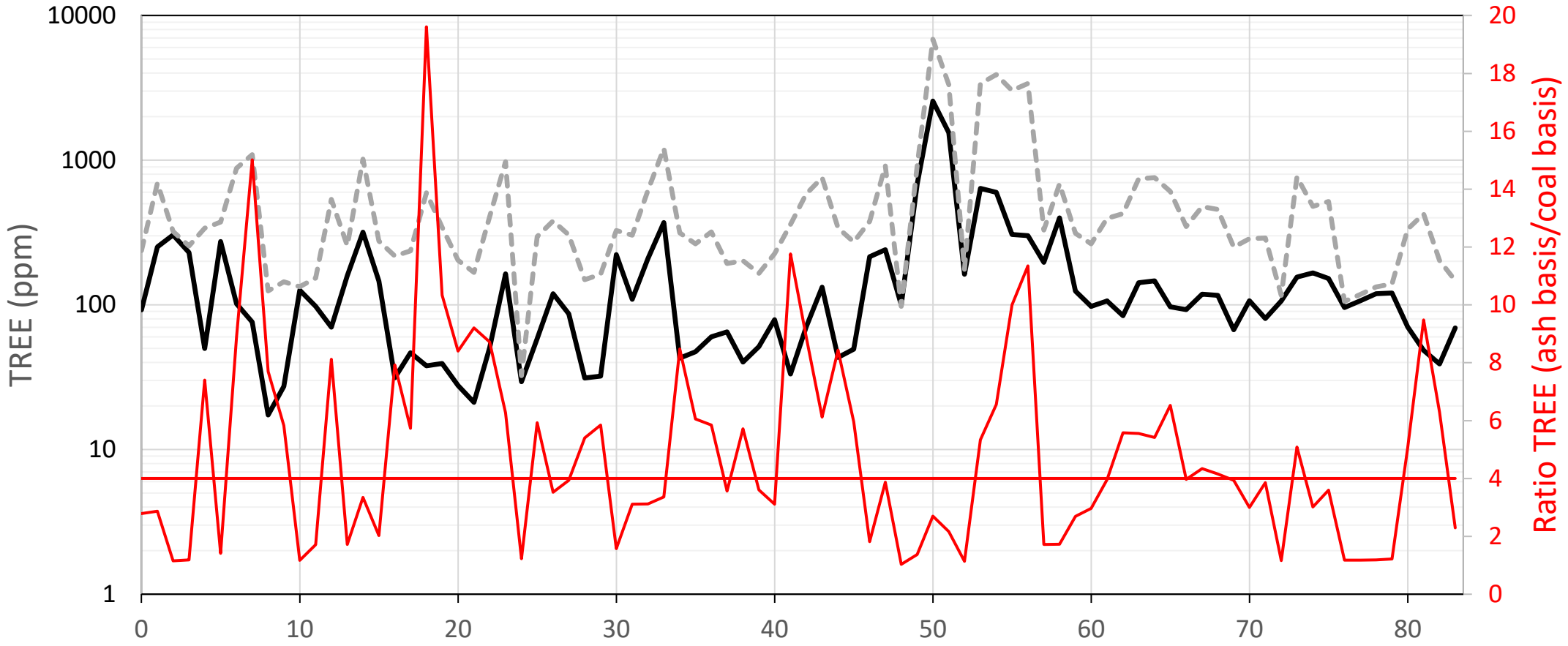


Total resources: 84 Gigatons (Gt) in upper 90 m

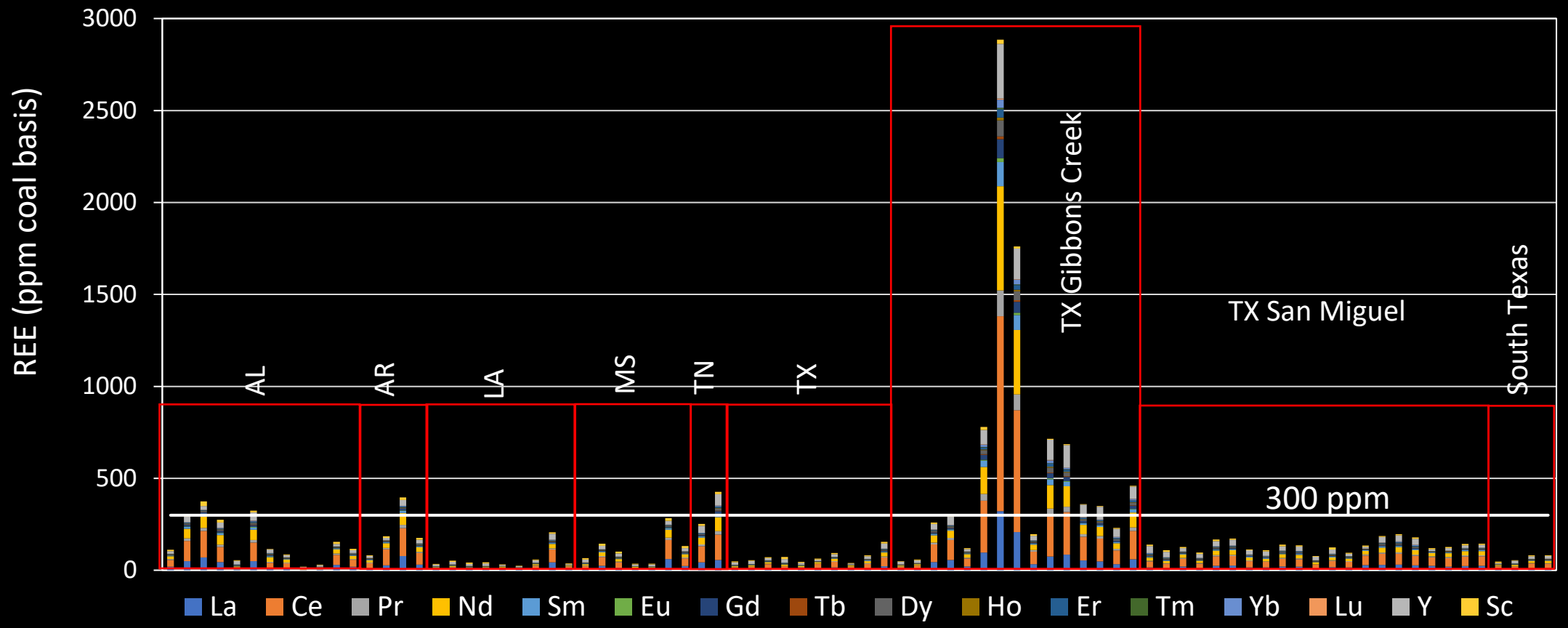
Gulf Coast: Total REE + Y + Sc



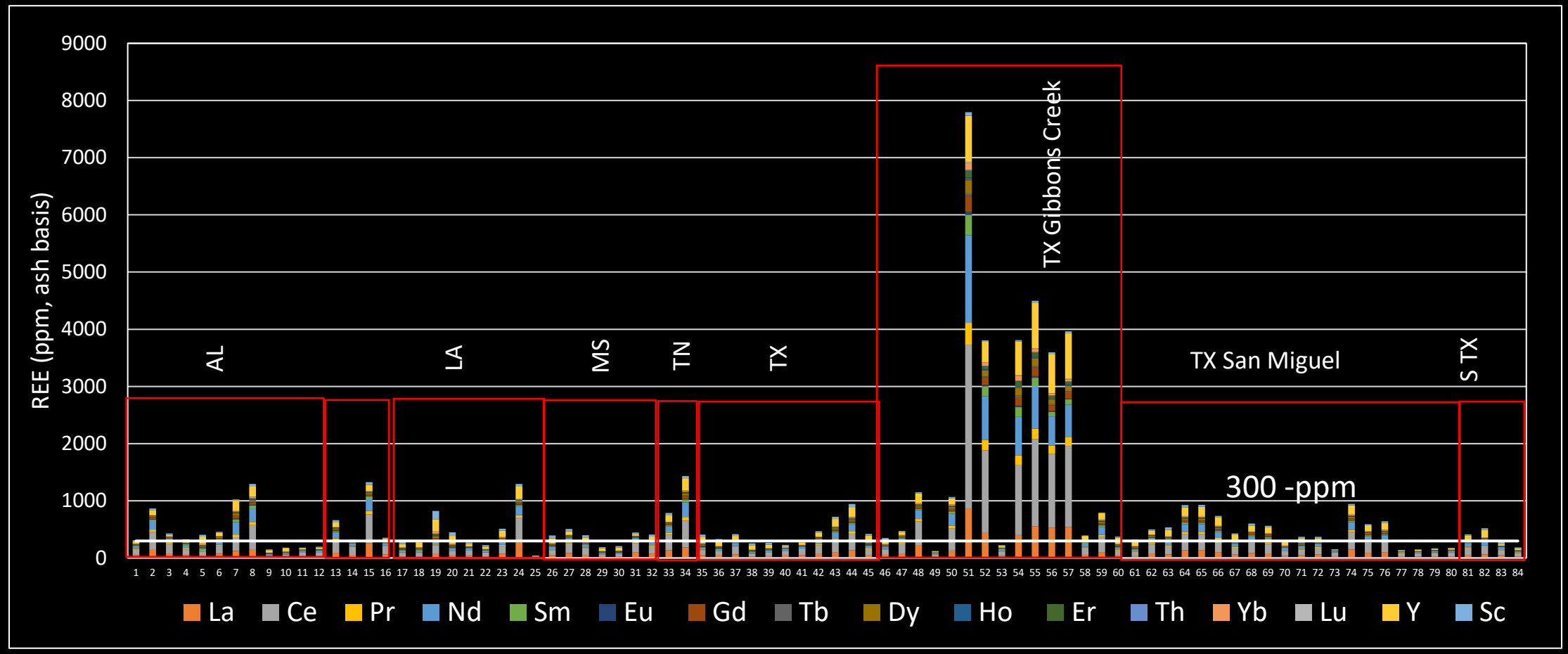
Total REE: Ash basis = 4× Coal basis (median)



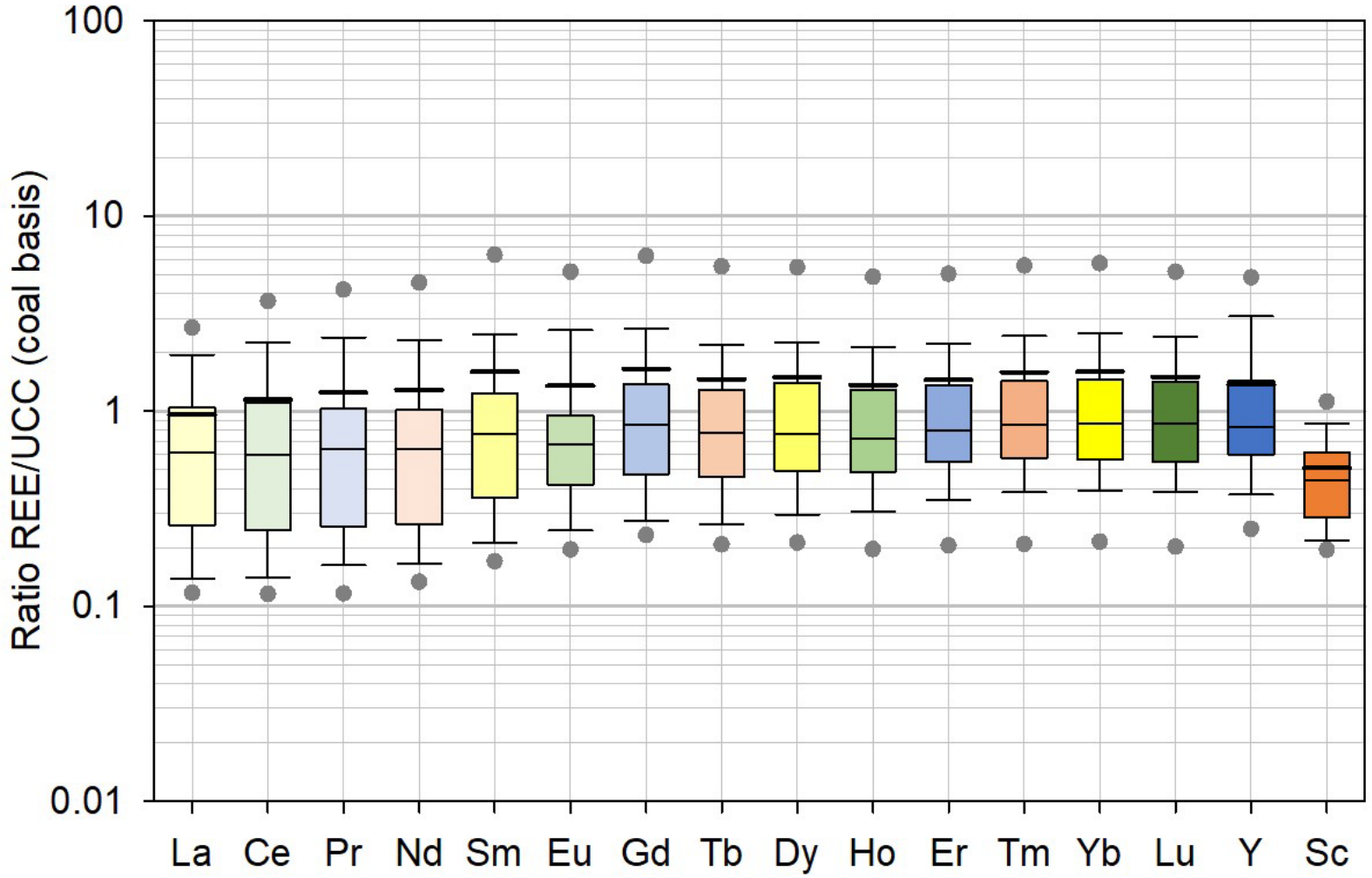
Gulf Coast: REE Levels (coal basis)



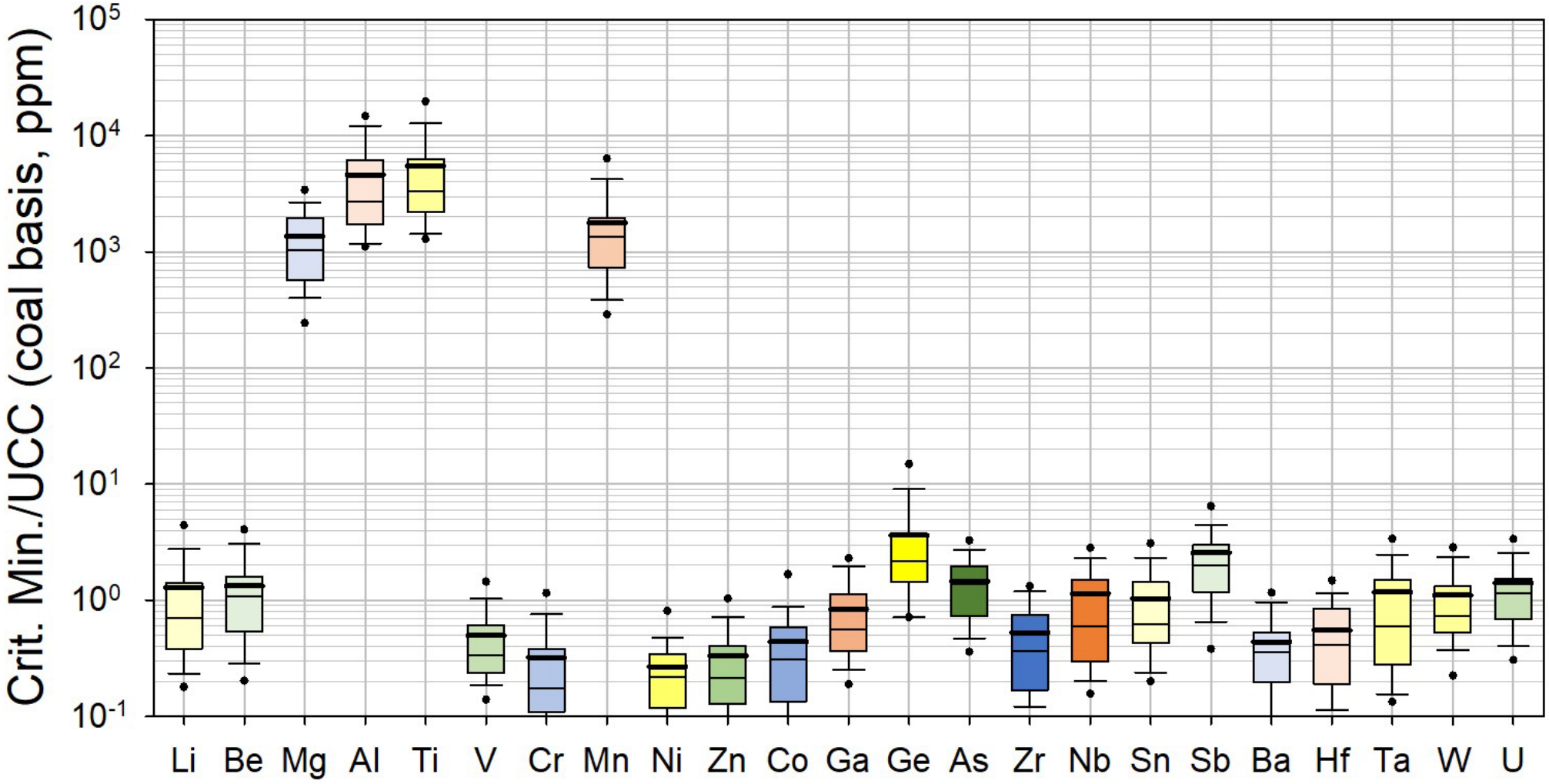
Gulf Coast: REE levels (ash basis)



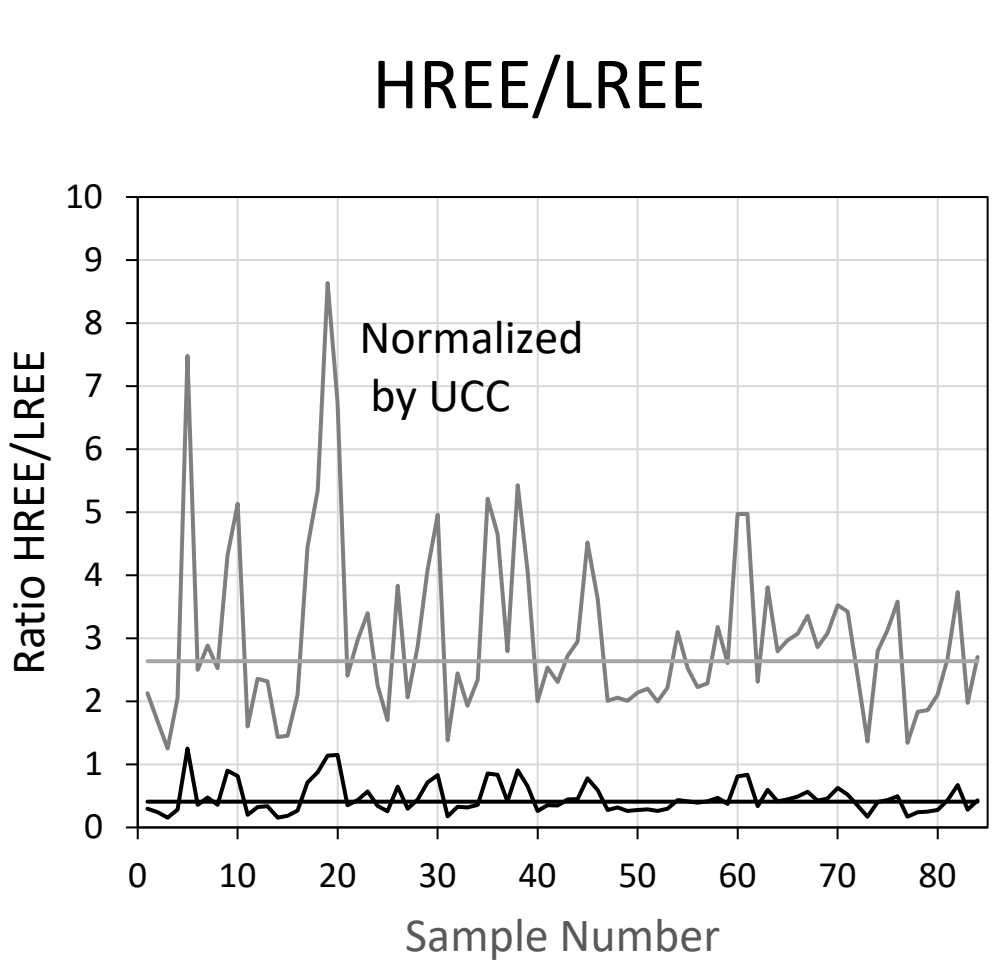
Gulf Coast Ratio REE to Upper Continental Crust

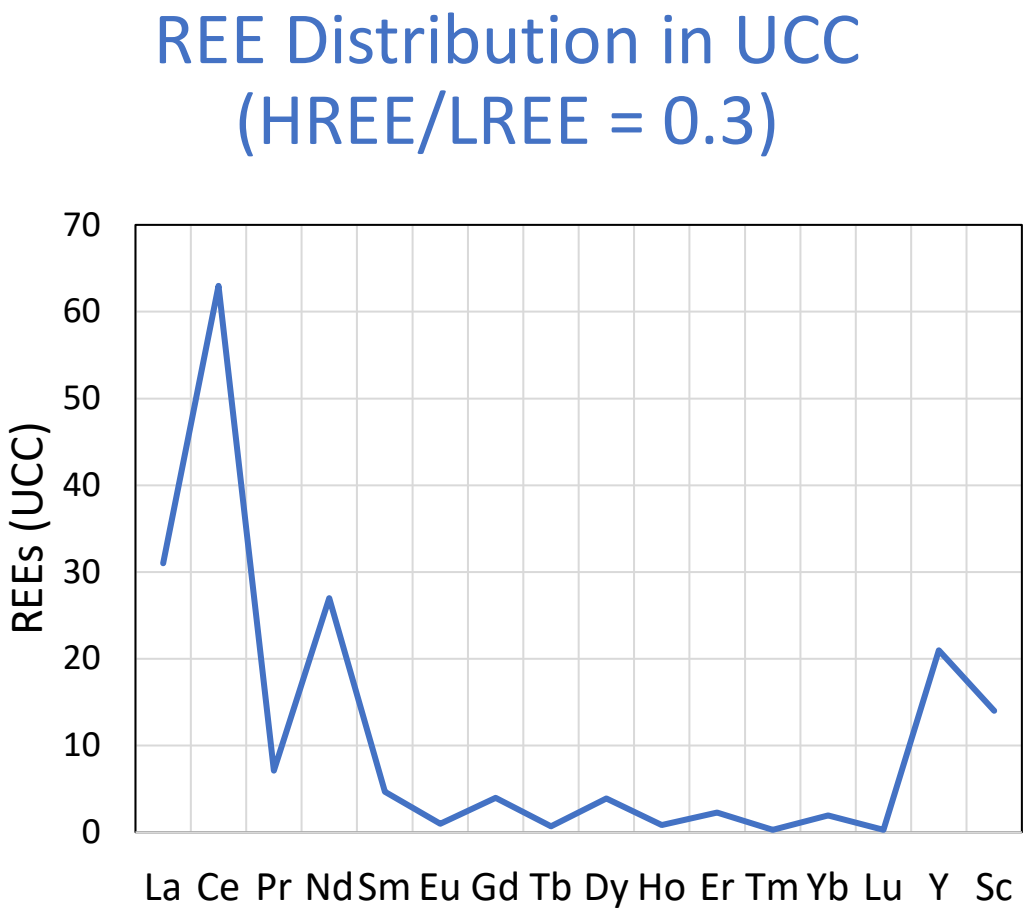


Gulf Coast Ratio Critical Minerals/UCC



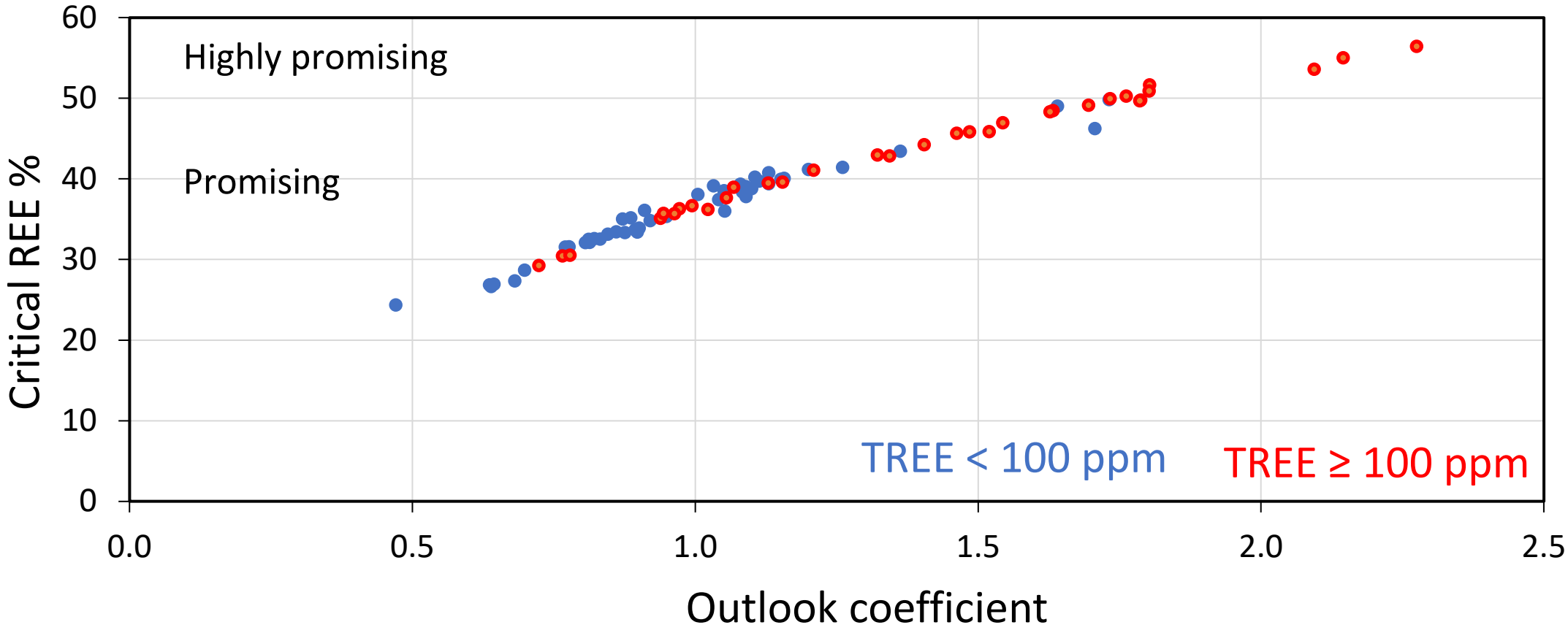
Ratio of Heavy to Light REEs varies with UCC normalization





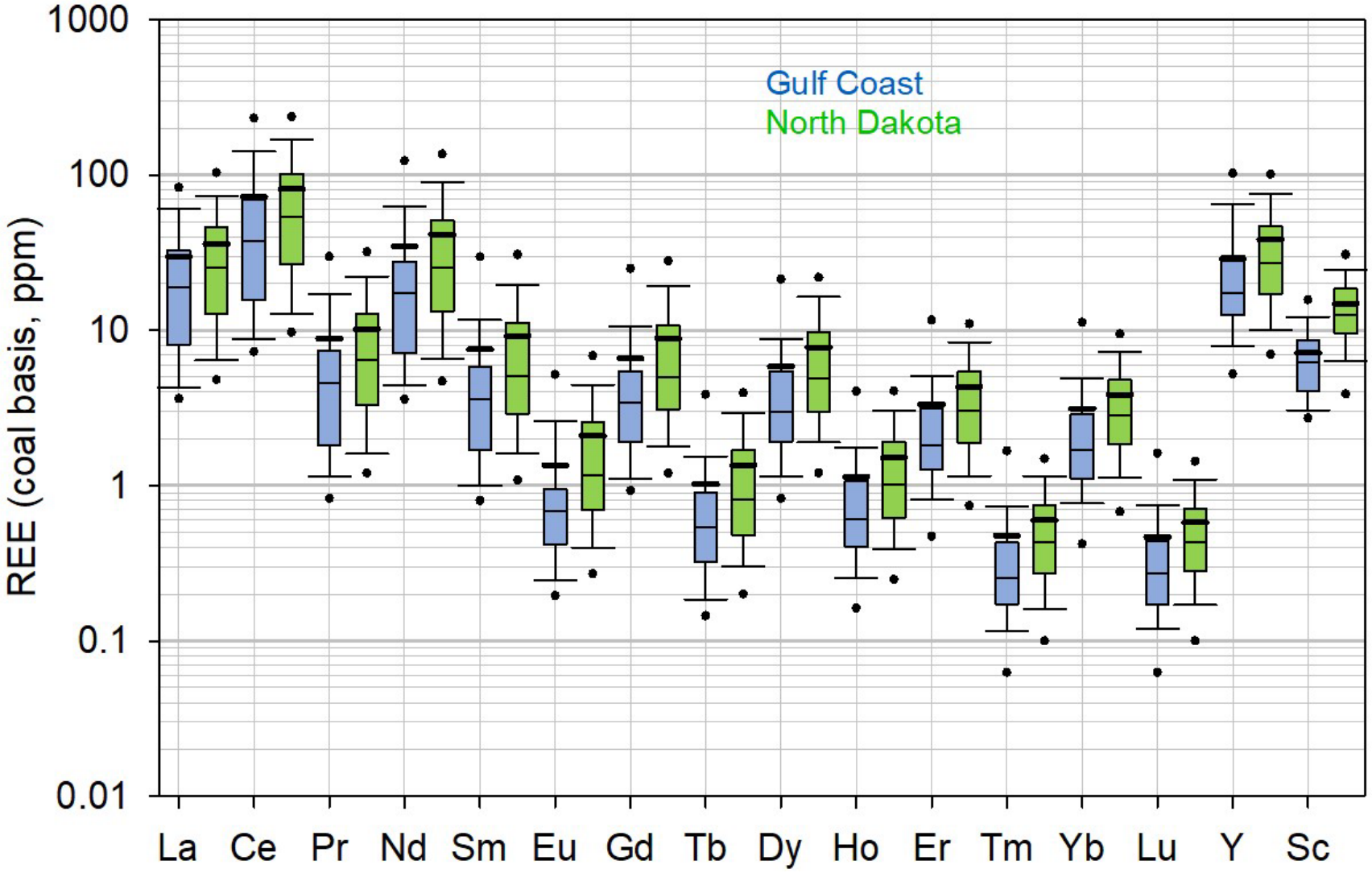
The ratio of heavy to light REEs is almost 3× higher when you normalize by UCC.

Critical REE % vs Outlook Coefficient



Outlook coefficient: = (Nd + Eu + Tb + Dy + Er + Y/∑REEY)/(Ce + Ho + Tm + Yb + Lu/ ∑REEY)
Outlook coeff. > 0.7 promising, > 3.1 highly promising
Critical REE % > 50% promising; > 70% highly promising

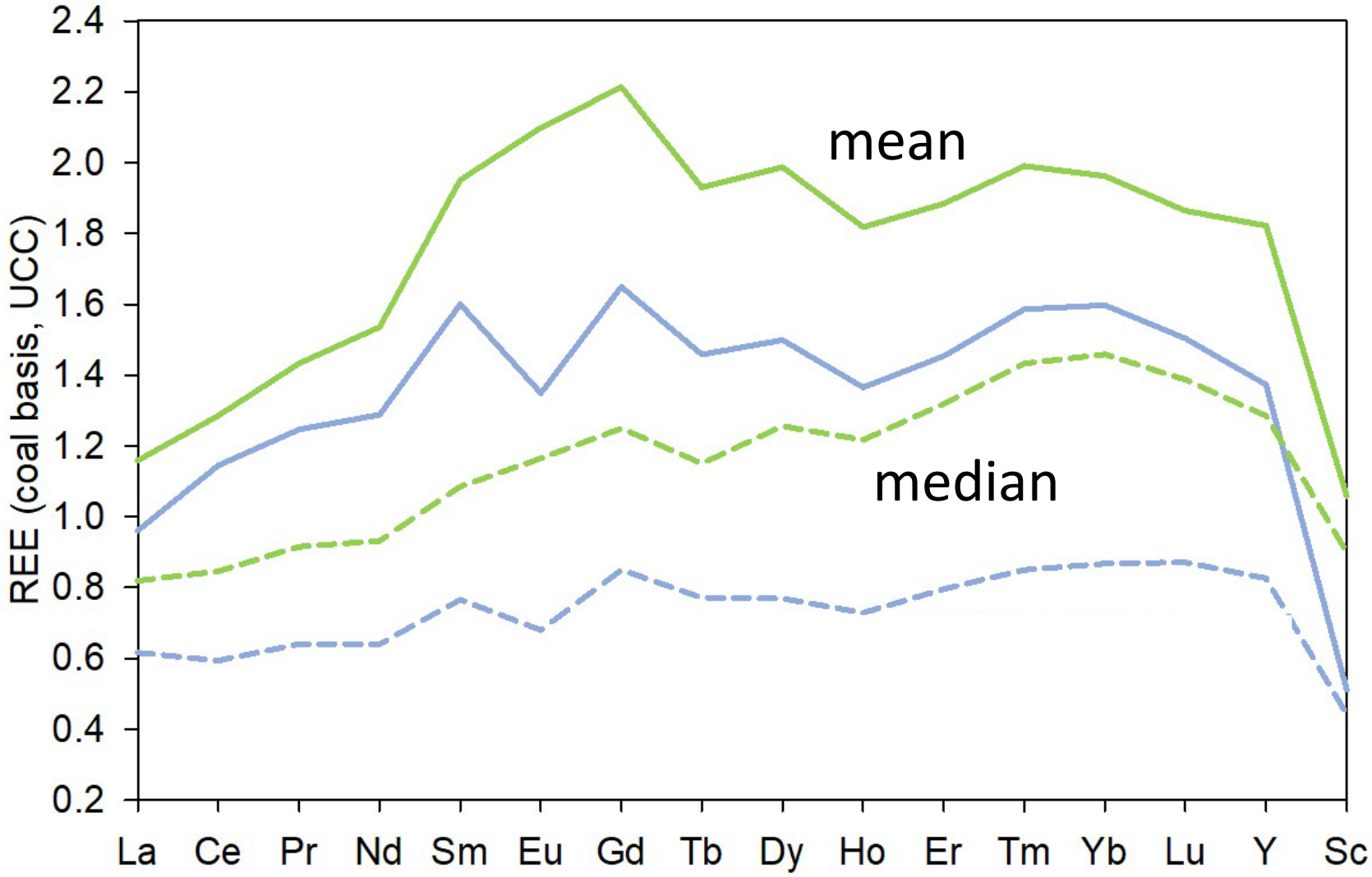
Comparison of REE levels in Gulf Coast and North Dakota



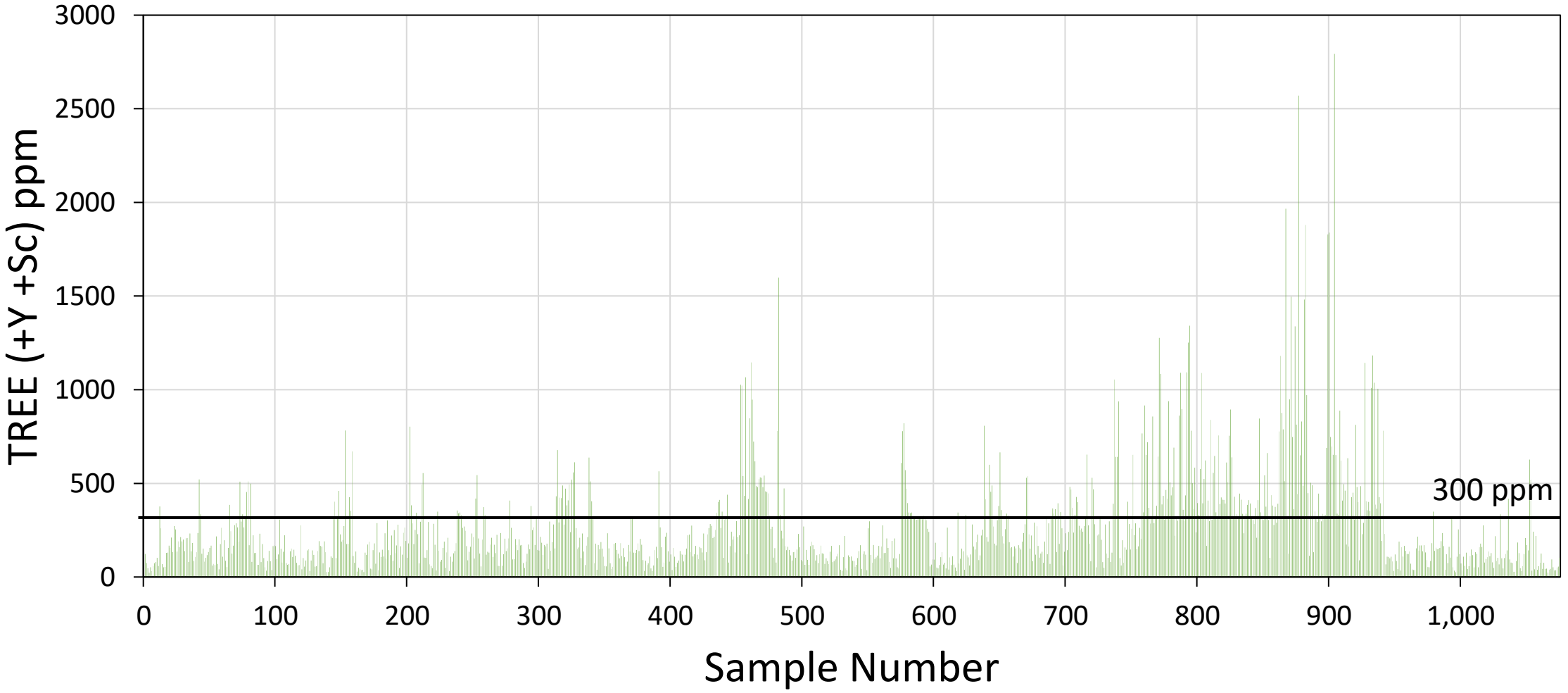
TREE (+Y +Sc) **Gulf Coast**: Mean 183 ppm; Median 101 ppm; Count: 84

N Dakota: Mean 262 ppm; Median 172 ppm; Count: 1076

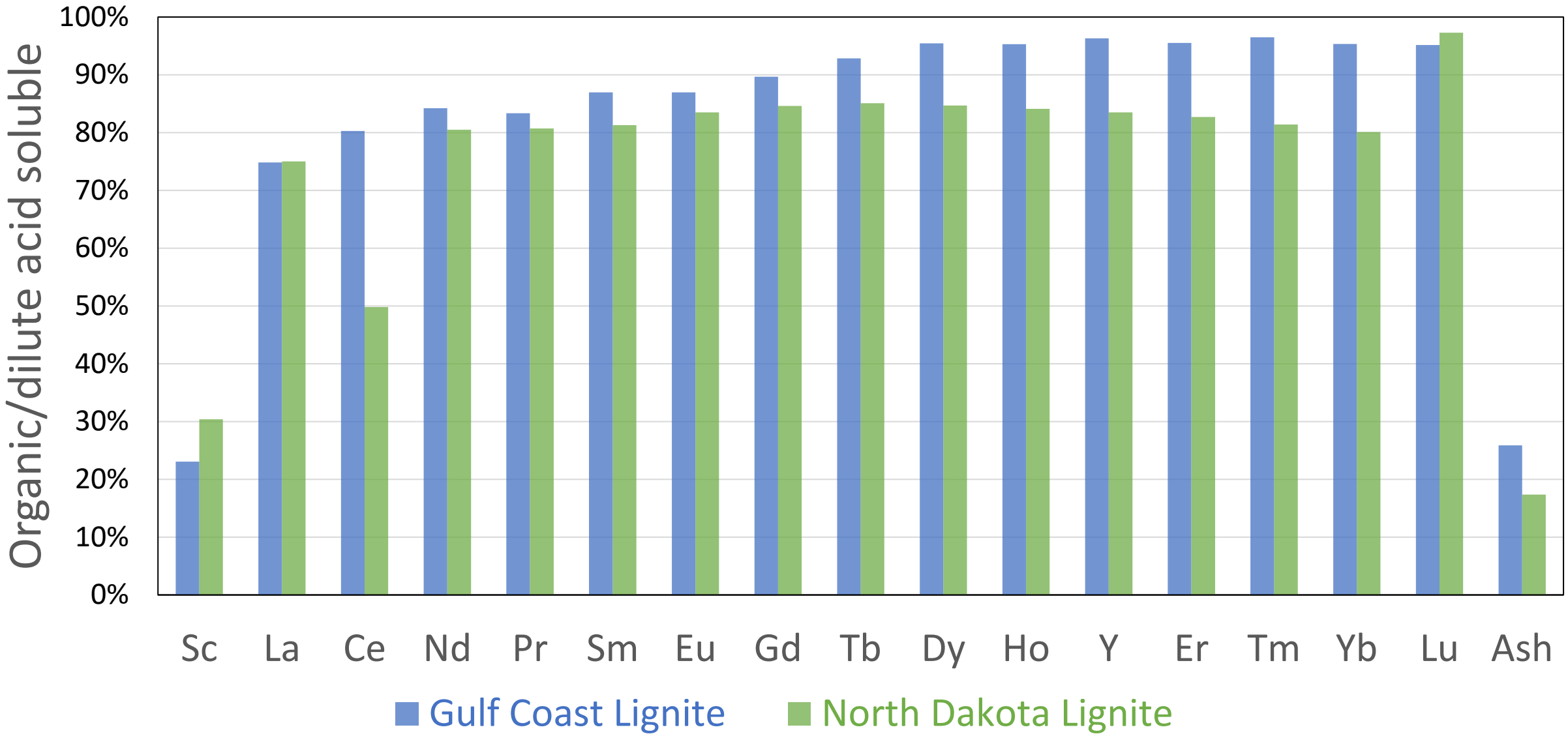
Comparison of REE levels (Gulf Coast, N Dakota)



N Dakota Total REE (+Y +Sc) (coal basis)



REE Extractability (Gulf Coast, N Dakota)



Theaker, Univ. N Dakota

Path Forward

- **Coal/Ash**
  - Additional sampling and analysis:
  - Coal (drilling, coal seeps)
  - Coal ash samples
- Increased no. of samples for extraction, coal and ash(Theaker)
- **Bauxite**, red mud, trash to treasure, TX, AR (Rich Kyle)
- **Graphite** mines
- **Heavy mineral placer deposits**
- **Volcanic ashes** (e.g., Catahoula in Texas)

Summary

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