Sedimentary molybdenum and uranium sequestration in a non-euxinic coastal setting: role of the sulfate-methane transition zone

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1. INTRODUCTION
- Long-term paleo-redox records vital for mitigating global expansion of coastal hypoxia
- Molybdenum (Mo) and uranium (U) commonly used in sediment-based redox reconstructions (Algeo and Tribouxillard, 2009; Brüseke et al. 2020)
- Conservative behavior under oxic conditions
- Uniform concentrations in the ocean due to long residence times (>0.5 Ma)
- Conversion to particle-reactive species in specific redox zones (Fig. 1)

2. STUDY AREA
- Setting: Eutrophied coastal area in the Gulf of Finland (Baltic Sea)
- Rationale: Eutrophication has led to formation of a shallow SMTZ (relatively stable)

3. MATERIALS AND METHODS
- Sediment cores from four stations
  - Solid-phase + pore water samples
  - Solid-phase analyses:
    - Total contents of Mo and U + major constituents
    - Speciation of Mo and U (Sequential extraction)
    - Pore water analyses
      - Concentrations of Mo and U + major constituents
      - Calculation
        \[ M_{SMTZ} = M_{sample} \times \frac{M_{SMTZ}}{M_{sample}} \]

4. RESULTS AND DISCUSSION
- Key feature: Simultaneous sequestration of both Mo and U within the SMTZ at two specific fronts coupled to increases in pore water H₂S concentration (Fig. 4)
- Diffusive fluxes of Mo and U = Mass accumulation rates of authigenic Mo and U
- Quasi-steady state
- Depletion of pore water Mo and U within the SMTZ

5. CONCLUSIONS
- Contrary to the existing theory, simultaneous uptake of Mo and U driven by H₂S levels
- Depth and intensity of the SMTZ control authigenic sequestration of both Mo and U
- Indirect link between bottom water oxygenation and Mo/U uptake
- Viable paleo-redox proxies (Mo more robust)
- Caveat: Limited temporal resolution due to the superimposed character of the signal

REFERENCES

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