# ANALYTICAL SEMINAR

## Emanuela Doll

Graduate Student
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***"What Did the Megalodon Eat? MC-ICP-MS Zinc Isotopes as a Trophic Proxy in Fossil Teeth"***

Classical trophic proxies such as $\delta^{15}N$ in collagen degrade beyond ~1 Ma, leaving the dietary ecology of ancient fauna largely inaccessible. Zinc isotope ratios ($\delta^{66}Zn$) measured by MC-ICP-MS offer a powerful alternative - zinc fractionates predictably during intestinal absorption at each trophic step, and this signal is permanently locked into dental enameloid, a biomineral that survives for hundreds of millions of years. The ±0.03‰ precision of MC-ICP-MS is uniquely capable of resolving the ~0.2‰ per-step trophic differences invisible to conventional instrumentation. I present recent applications of this technique to fossil shark teeth spanning the Miocene-Pliocene, demonstrating that $\delta^{66}Zn$ by MC-ICP-MS can reconstruct trophic position across deep geological time, and reveal a 20-million-year ecological story culminating in the extinction of the largest predator that ever lived.

# ANALYTICAL SEMINAR

## Shiva Ataei

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### *"A Matter of Nanometers: TR-FRET Bioassays for Rapid Detection in Complex Biological Matrices"*

Time-resolved Förster resonance energy transfer (TR-FRET) is a homogeneous, mix-and-read analytical technique that enables highly sensitive and quantitative bioassays in complex biological matrices. By employing lanthanide chelates as energy donors, TR-FRET takes advantage of microsecond-to-millisecond excited-state lifetimes that are orders of magnitude longer than the nanosecond autofluorescence of biological samples. The introduction of a delay between excitation and signal collection suppresses short-lived background emission while preserving the long-lived lanthanide-sensitized acceptor signal, resulting in substantially improved signal-to-background ratios. Continued advances in lanthanide probe design have further strengthened this platform through enhanced molar absorptivity, improved aqueous stability, and versatile bioconjugation strategies. Applications in infectious disease serology and clinical biomarker detection highlight the versatility of TR-FRET as a rapid, wash-free, and low-background method for bioanalysis, particularly in settings where assay sensitivity, operational simplicity, and reliable performance in serum and other complex samples are essential.