BANDED IRON FORMATIONS OF THE QUADRILÁTERO FERRÍFERO MINAS GERAIS, BRAZIL AS ARCHIVES OF BIOSPHERIC EVOLUTION B. K. Lee [1]*, H. Tsikos[2], E. Oliveira[3], A. Bekker[1], T.W. Lyons[1], [1] University of California Riverside, USA (* correspondence blee045@ucr.edu), [2] Rhodes University, Grahamstown, South Africa, [3] University of Campinas, São Paulo, Brazil.

Introduction: The development of Earth's oxygen-rich atmosphere is a key factor in the evolution of complex (multicellular) life [1]. Geologic and geochemical constraints support low to negligible concentrations of atmospheric O_2 during the Archean and earliest Proterozoic [2-5], and the rise of atmospheric O_2 is a milestone in the history of life on Earth. Iron Formations (IFs) record the evolution of oxygenic photosynthesis and dissolved O_2 concentrations in the oceans [6], while providing multiple lines of evidence for a broad range of environmental conditions present at the time of their deposition during the Archean and Paleoproterozoic. IFs are direct manifestations of seawater redox conditions, specifically the balance between iron, sulfide, and oxygen availability. At the same time, they can be faithful recorders of the broader isotopic and elemental composition of seawater, which can track the micro- and macro-nutrient conditions for diverse ancient marine life [7-9].

IFs from Cauê Iron Formation of the Minas Supergroup in the Quadrilátero Ferrífero (QF) ("Iron Quadrangle") are located along the southern edge of the São Francisco craton. The Cauê Iron Formation, a Superior-type IF, is likely coeval with IFs of the Transvaal and Hamersley basins, which have received significantly more geochemical attention [10]. The geochemical properties of IFs from the QF are poorly known, although previous studies suggest mild oxygenation of seawater during deposition of the Cauê Iron Formation around 200 million years before the Great Oxidation Event (GOE) based on negative anomalies of Ce and low Th/U ratios [11] and acidic, terrestrial aqueous conditions based on high Cr concentrations at some horizons within the Cauê Iron Formation [8]. The strength of our study, still in its preliminary phase, is the exceptional access to samples from drill cores from a relatively understudied region of the world—recording a critical interval in biospheric evolution.

Our goal is to evaluate environmental changes spanning the Archean–Paleoproterozoic boundary. Our drill core samples are unweathered and among the least altered material available from the Caraça (2.6 Ga) and Itabira groups (2.4 Ga). Our nearly 250 samples cover the sequence of shales from Batatal Formation, IF from Cauê Iron Formation, as well as its transition into the dolostones of the overlying Gandarela Formation. We will discuss the related redox cycles for iron (Fe) and manganese (Mn) by analyzing their concentrations along with Fe isotope signatures that will potentially fingerprint the pathways of precipitation of iron under conditions ranging from oxic to anoxic. Where possible, independently constrained redox relationships from associated carbonates will provide the essential background for our study of controls on Fe and Mn mineralization. Importantly, IF archives for seawater copper, an enzymatic cofactor for most photosynthetic prokaryotes organisms, and nickel, among other bioessential elements, will be discussed in detail.

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