The advantages and limits of ITRAX core scanner: Learning by comparison with destructive element and isotope data from the Gulf of Alaska sediment core

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ITRAX is a new non-destructive, rapid, automated multi-function core scanner, developed by the Southampton Oceanography Centre (now National Oceanography Centre, Southampton, UK) and the Cox Analytical Systems of Gothenburg, Sweden. The instrument incorporates an intense micro-X-ray beam being designed to gather optical and micro-radiographic images and X-ray fluorescence (XRF) spectrometry elemental profile that provides high-resolution geochemical records from terrestrial and marine sediment cores. Rothwell and Croudace (2015) showed that 60 elements or ratios measured by XRF core scanner have been used for core characterization, determination of climate changes, recognition of sedimentological events like ash layers, turbidites, ice-rafted debris, and aeolian dust, provenance studies, facies interpretation, diagenetic studies, and core correlation studies.

However, despite its rapid acquisition of high-resolution multi-elemental data, there are some limitations and cautions. That is ITRAX core scanner measures element intensities in total counts or count per second, and intensities may be affected by the X-ray source, measurement time, other elements, physical properties of the sediment and protection foil, potentially leading to large uncertainties for paleoenvironmental interpretation. Thus, to correctly interpret ITRAX data, destructive element data measured by ICP-MS, ICP-OES, and WD-XRF are also still needed.

Recently, we had the experience to use the ITRAX XRF core scanner for our sediment core CL14PC (Gulf of Alaska, 59° 33.35´N, 144° 09.35´W, water depth 690 m) at the CMCR, Kochi University, Japan. Our sediment slab sample was 5 cm wide, 100 cm long, and 1 cm thick, and we operated with a molybdenum (Mo) anode tube at 20 seconds, with 30 kV (voltage) and 55 mA (current) and with 0.4 mm and 1 cm resolution. We also measured element concentration with WD-XRF and ICP-MS, and Sr-Nd-Pb isotopes of bulk sediments. We found that ITRAX XRF counts for the element K, Ca, Ti, Mn, Fe, and Sr represented lower correlation (R^2) with WD-XRF concentration data (wt%). Especially, the deviation was higher in the core-top for K and Ti. We discussed that high Cl content in the soupy core-top sediments reduces K count by absorption of the Kα fluorescence of K and Ti intensities may be decreased towards core tops due to lower compaction and high dilution by high porewater content. We also found very low counts in the case of Al and no signal (counts) for Mg, indicating that molybdenum (Mo) X-ray tube in the ITRAX system cannot detect these elements, although detection of Al in the currently available model using Cr tube is good. Further, in the presentation we will also present XRF-based provenance proxy data and Sr-Nd-Pb isotopes of bulk sediments of geochemical tracers.

Keywords: ITRAX, WD-XRF, bromine, Sr-Nd-Pb isotope, provenance analysis

