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Exploring the ecology of catfish through trace elements analyses of otolith by LA-HR-ICPMS to reconstruct palaeo-SST

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Otoliths are incrementally precipitated aragonite biominerals found within the inner ear of all teleost fish. Previous studies show that oxygen isotopes (δ18O) of otolith aragonite precipitate in equilibrium with those of seawater regarding ambient water temperature (Campana, 1999). Therefore, (δ18O) of otolith can be used as a strong thermometer for reconstructing the past environment. In the meantime, fish habitats are necessary to be revealed before understanding the palaeoenvironments using otolith due to its nature as biomineral associated with fish. Thus we applied trace element measurements in the specimens to identify the habitable zones namely marine, brackish and freshwater. Strontium abundance in carbonate samples (Sr/Ca) is the best indicator to be employed because of distinct differences in concentration in marine and riverine waters (Walther and Thorrold, 2006). The present study is therefore aiming for identifying the past fish ecology using Sr/Ca in otoliths measured by newly developed laser ablation (ArF excimer) high resolution inductively coupled plasma mass spectrometry (LA-HR-ICPMS). The study area is the Gulf of Kutch in Gujarat district, northwestern part of India. This area is strongly influenced by Indian monsoon, which is characterized as distinct seasonal rainfall (humid summer and dry winter). Salinity distribution within the Gulf of Kutch is unusual compared with general river-estuary system. Lower salinity (˜37) is observed in the inner part, whereas higher values (>40) are observed near the mouth (Vethamony et al., 2007). In this study, we analyze both modern and fossil otoliths. Fossil otoliths were excavated from archaeological sites of Harappan Civilization located in Bagasra and Datrana. According to otolith morphology, they probably the otoliths of Siluriformes Ariidae catfish, known as marine catfish. Trace element concentrations relative to Ca (23Na, 25Mg, 55Mn, 88Sr and 137Ba / 43Ca) were measured along with growth bands of otoliths. They are measured using LA-HR-ICPMS. The system is consisted with Thermo Finnigan Element XR high resolution inductively coupled plasma mass spectrometer coupled to Resonetics 193 nm excimer laser ablation system installed at Atmospehre and Ocean Research Institute. Nine modern and 16 fossil otoliths thin sections were prepared and 6 modern and 4 fossil sections were analyzed using LA-HR-ICPMS.Abrupt changes in Sr/Ca with an amplitude of as much as 3 mmol/mol within ˜2 weeks suggest fish migration between freshwater and the seawater. From a conservative mixing model for Sr/Ca of estuarine water, the fish has migrated to riverine environment sometimes in their life since the model predicts small changes in Sr/Ca of water if salinity is higher than ˜5 unit. It is rather changes in Sr concentrations in ambient water than that for water temperature or salinity in the gulf.

Keywords: otolith, trace element, oxygen isotope, LA-HR-ICPMS, Gulf of Kutch