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AVIS DE SOUTENANCE DE THÈSE

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Monsieur Sikandar HAYAT

candidat au diplôme de Doctorat de l'Université d'Angers, est autorisé à soutenir publiquement sa thèse

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Faculté des Sciences
2, boulevard Lavoisier
49045 ANGERS Cedex 01

sur le sujet suivant :

Foraminiferal-based proxies to track the dynamics of the Peruvian coastal upwelling system: past and present perspectives

Directrice de thèse : **Madame Meryem MOJTAHID**

Composition du jury :
Monsieur Jorge AQUILES CARDICH SALAZAR, Lecturer UPCH Lima, Perou, Co-encadrant
Madame Mary ELLIOT, Professeure des Universités Nantes Université, Co-directrice de thèse
Madame Frédérique EYNAUD, Maîtresse de Conférences HDR Université de Bordeaux, Rapporteure
Monsieur Robin FENTIMEN, Maître de Conférences Université d'Angers, Examinateur
Monsieur Patrick GRUNERT, Professeur Université de Cologne, Allemagne, Rapporteur
Monsieur Dimitri GUTIERREZ, Professeur Université Cayetano Heredia, Perou, Examinateur
Madame Laetitia LICARI, Maîtresse de Conférences CEREGE Aix-en-Provence , Examinatrice
Madame Meryem MOJTAHID, Professeure des Universités Université d'Angers, Directrice de thèse
Monsieur Matthieu CARRÉ, Professeur CEA-CNRS-UVSQ Gif sur Yvette, Membre invité
Madame Maria TRIANTAPHYLLOU, Professeure NKUA Athènes, Grèce, Membre Invité

Résumé de la thèse

The Peruvian margin hosts one of the shallowest and most intense oxygen minimum zones (OMZs) in the global ocean and is a major site of fixed-nitrogen loss. Predicting how this OMZ will respond to climate change requires knowing how its oxygen varied before human influence. Benthic foraminifera are the principal tool for such reconstructions because their assemblages track bottom-water oxygen (BWO). On the Peruvian margin, however, their use has been limited for three reasons: identification is slow and laborious, which keeps temporal resolution coarse; previous quantitative paleo-BWO records come from the lower boundary of the OMZ rather than from its core; and many sediment intervals are devoid of foraminifera. This thesis addresses these limitations through two approaches. The first establishes the methodological and interpretive foundations for foraminifera-based oxygen reconstructions. To accelerate identification and counting, a convolutional neural network was trained on Peruvian benthic foraminifera. It achieved 92% accuracy and produced results consistent with manual identification. Millimeter-scale observations of living benthic foraminifera in Paracas Bay reveal how oxygen, nitrate, sulfide, and carbonate chemistry structure the living assemblages and govern the transfer of tests into the fossil record. The second approach applies these foundations to reconstruct OMZ changes across time and depth. BWO reconstructions based on the extended Benthic Foraminifera Assemblage index (BFA_{ex}) show that the OMZ core has remained near-anoxic for the last 650,000 years, with no clear glacial-interglacial contrast. This near-anoxic state was interrupted only by short oxygenation events, the most pronounced of which occurred during Heinrich Stadial 1, coinciding with stronger El Niño activity. In Paracas Bay, foraminifera were preserved mainly during the mid-Holocene El Niño-Southern Oscillation minimum. Micro-computed tomography, X-ray fluorescence, assemblage composition, and comparison with previously published redox-sensitive metal records show that the barren intervals result from diagenesis rather than ecological exclusion. Foraminifera lived on the seafloor, but their calcareous tests dissolved when reduced sediments were intermittently reoxygenated. Comparison with previously published BWO records reveals a vertically decoupled OMZ, in which each layer responds to different controls.

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