Trace element mobility and root iron plaque effects on rice growth in a coal mining area of North Vietnam

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The Cam Pha area in Northen Vietnam is known for its coal mining activities. The Coc Sau open pit coal mine has been operative in this area for at least the past 50 years. Rice paddies located ~2 km away from the Coc Sau mine are irrigated with water contaminated by acid mine drainage. Bulk chemical analysis of rice paddy soil from the Cam Pha area shows relatively high concentrations of several toxic metals attributable for the most part to the coal mining activities, including Cr, Cu, Zn, As, Cd, and Pb (60, 27, 48, 14, 0.2, and 35 ppm, respectively).

Preliminary experiments with model *Oryza sativa* cv. (Asia) rice species exposed to contaminated paddy soil from the Coc Sau mining area showed a hindered growth as a function of increasing soil concentrations added to rice growth media under controlled laboratory conditions. Figure 1 shows a clearly a detrimental effect of this soil on the growth of model *Oryza sativa* cv. (Asia) rice species.

In the next step, we will perform sequential extraction analyses of the soil to determine the most mobile metals. Moreover, we are currently studying the effects of root iron plaques and the presence iron oxide mineral phases in regards to toxic metal immobilization.

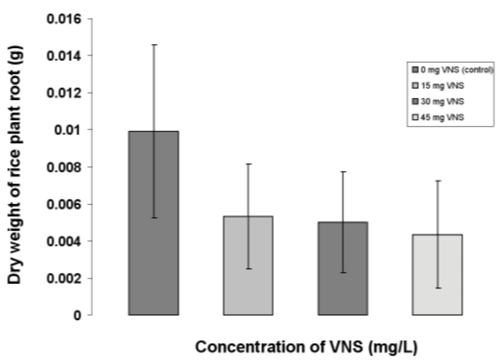

Figure 1: Plot of dry rice plant root weight as a function of concentration of Vietnamese rice paddy soil (VNS) from Cam Pha area.

δ^{11}B-based atmospheric CO_2 records during the Pliocene at orbital resolution

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The Mid-Pliocene is the most recent time in Earth's history when mean global temperatures were substantially warmer and sea levels higher than they are today [1]. The subsequent intensification of the Northern Hemisphere Glaciation (iNHG) represents the key final step in the climatic transition from the warm Pliocene to the current "icehouse" climate. Recent modeling and proxy-based results [2-4] suggest that this climate shift was forced by a reduction in atmospheric CO_2 concentrations (pCO_2), which highlights the relationship between climate and this important greenhouse gas. Hence, there is significant potential in the use of the Pliocene as an analogue for future global warming in modeling studies and as a key period to study the role of CO_2 in driving major climatic shifts. Despite recent advances in the reconstruction of pCO_2 change during this important period [3-4], detail at the orbital scale is currently lacking.

Boron isotopes in planktic foraminifera are a proven proxy for surface oceanic pH [5], which has been shown to provide valuable insights into past changes in the ocean carbonate system and ultimately into past atmospheric pCO_2. Here we will provide foraminiferal δ^{11}B-based records to determine the temporal evolution of pCO_2 for an interval spanning the Pliocene Warm Period and the iNGH at orbital scale temporal resolution. Our record provides valuable insights into the causes and consequences of the changes in the atmospheric concentration of this important greenhouse gas.

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