

## Land ocean interactions in a coastal embayment, Kaneohe Bay, Hawaii: Nutrient dynamics, productivity, and CO<sub>2</sub> exchange between seawater and atmosphere

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Human activities throughout the past two centuries have generated large increases in the atmospheric content of greenhouse gases, leading to higher global mean surface temperatures. The warming of oceans may increase the frequency of storms, which facilitate the transfer of nutrients, sediment, and pollutants from rivers into coastal ecosystems. Increased oceanic CO<sub>2</sub> concentrations attributable to anthropogenic input lower the saturation state of seawater with respect to carbonate minerals, can cause "ocean acidification" and have been argued by some to negatively impact calcification (e.g., Kleypas, 1999; Orr, 2005). Coastal areas and estuaries, however, may be either net annual sources or sinks of atmospheric CO<sub>2</sub> (-41 to 7.3 Mole C m<sup>-2</sup> yr<sup>-1</sup>, Mackenzie and Lerman, 2006).

We present here results from 18 months of observations at CRIMP-CO<sub>2</sub>, a collaborative effort in Kaneohe Bay, Hawaii between UH Manoa and NOAA/PMEL. This buoy was the first coastal buoy of the NOAA/PMEL-CO<sub>2</sub> program. CRIMP-CO<sub>2</sub> has documented the response of bay waters to pulsed inputs throughout a La Niña winter season (2005-06) and the much drier winter of 2006-07. The evolution of bay waters following storm-derived inputs was studied, along with the impacts of blooms and physical forcing on the air-sea exchange of CO<sub>2</sub>. Physical forcing strongly influences system response, in particular stratification and mixing, hence controls both the duration of blooms and attendant changes in CO<sub>2</sub> concentration. Southern Kaneohe Bay often becomes a CO<sub>2</sub> sink following storm inputs (0.2-0.7 m Mole C m<sup>-2</sup> hr<sup>-1</sup>), but remained a net source of CO<sub>2</sub> to the atmosphere (-1.06 Mole C m<sup>-2</sup> yr<sup>-1</sup>) throughout our study period. This result is similar to estimates from Hog Reef flat in Bermuda and from the Scheldt Estuary plume (-1.2 and -1.1 to -1.9 Mole C m<sup>-2</sup> yr<sup>-1</sup>, respectively, Mackenzie and Lerman, 2006).

## Diamonds, xenoliths and kimberlites: A window into the Earth's Mantle.

### UNESCO IGCP 557

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The principal aim of this study is to develop a dynamic process based understanding for the formation of the e- and p-type diamonds. A joint study of the petrology and geodynamics of diamond bearing rocks is thus understood as a space-time window for unravelling deep processes in the Earth's Upper Mantle. Our assessment aims particularly at the migration paths of hydrogen in nominally OH-free minerals in xenoliths, their geological/geodynamic setting as well as their petrological evolution. Recently, a 3-D dimensional modelling tool for understanding the geometry of a subduction zones was developed (Morra, *et al.*, 2006). The new method comprises a novel Finite-Element/Boundary Element method (FEM/BEM) coupled to a thermodynamic solver (PERPLEX). The primary target of the code was to give a quantitative tool for modelling mantle tomography and geodynamics using the constraint of phase equilibria. Although the simulations are mainly geared at subduction/collision environments, both methods can be used in a much broader sense and thus provide a unique opportunity to test geodynamic settings for diamond formation in a truly quantitative manner. The strength of the FEM-BEM method of Morra and Regenauer-Lieb (2006), lies in the fact that the physical parameters derived from thermodynamic calculations provide a robust tool for predicting a geodynamic processes. In our approach, density contrasts and mineral chemical compositions are used for driving geodynamic processes occurring in a subduction zone. Material parameters, are equally derived and complemented by the best of our knowledge on rheological properties of rocks from laboratory data. We propose to compare the predicted phases with *in situ* observations using multi-scale laboratory analyses complemented by a high resolution synchrotron based FT-IR analysis to derive passage of aqueous fluids through the lithosphere. This latter technique has proven to be very powerful to map the formation of mineral inclusions in mantle minerals such olivine. The project is carried out under the auspices of an international UNESCO IGCP557 collaboration involving a large group of international scientists.

### References

- Morra, G., K. Regenauer-Lieb and D. Giardini, 2006, *Geology*, **34**(10), 877-880.  
Morra and Regenauer-Lieb, 2006, *Phil. Mag.* **86**(21-22), 3307-3323.