Intrinsic and Extrinsic Factors Governing Development of Time-Dependant Leaching/Depth Thresholds in Hawaiian Soils

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Sampling and Methods

Soils have been sampled across the Hawaiian Islands guided by state factor theory which dictate sampling along near orthogonal gradients of climate and time. Hawaii has strong gradients of both and due to the intersection of island topography and the dominant NE tradewinds, climate patterns have been quite stable over the last 4 my. In particular, climate gradients ranging from <500 mm to >3000 mm have been sampled on 10 ky, 150 ky, 400 ky, and 4000 ky lava flows. Soils were sampled to depth of backhoe and/or auger refusal and analysed for total element composition, soil physico-chemical exchange, mineralogical and plant nutrient properties.

Results and Conclusions

We observed distinct thersholds in soil depth and soil chemical properties that become more strongly expressed over time and that are expressed at rainfall values that decline from about 1800 mm at 10 ky, to 1300 mm at 150 ky, 1000 mm at 400 ky and 800 mm at 4000 ky. Below the threshold soil depth is a meter or less on the yonger flows and increases to between 3 and 4 m on the oldest flow. Above the threshold soil depth is between 1 and 2 m on the youngest flows increasing to about > 5 m on the intermediate age flows and to as much as 20 m on the oldest flow. Nutrient status as indexed by the fraction of non-hydrolizing cations sorbed to soil exchange complex changes strongly across the threshold but the difference varies according to flow age. Young and intermediate age flows show very strong differences whereas the oldest flows are quite depleted in cations even below the threshold. The observed thresholds are very sharp occurring over spatial distance of a km or less and over a rainfall distance of a few hundred mm. Although they are strongly expressed, the processes associated with formation of the thresholds are complex and are a response to both intrinsic and extrinsic variables. The dominant control of threshold location is related to the balance of rainfall and evapotranspiration. Where the latter predominates leaching and weathering depths are limited. Increasing amounts of rainfall lead to increased pore volumes of water which enhances both weathering depth and cation removal. However even at low rainfall occasional extreme wetting events serve to slowly deepen weathering depths and remove ions. Thus over time the threshold is expressed at lower rainfall values. On Hawaiiain shield surface erosion is quite low which allows these thresholds to be expressed in ways that might not occur in most landscapes.

Element impurities as time scale in otoliths of wild Prussian carp (*Carassius gibelio*): Implications for past environmental reconstructions

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Otoliths are paired structures composed of biogenic calcium carbonate in teleost fish inner ears [1]. Otoliths accrete new crystalline and protein material on to their exterior surface daily throughout fish's life, incorporating minor and trace elements, and are not re-metabolized once deposited [2]. These element impurities, which represent less than 1% of the otolith weight, provide a chemical chronology over the entire life of a fish. The combination of laser ablation with inductively coupled plasma mass spectroscopy (LA-ICPMS) is a powerful tool for determination of trace elements or elemental ratios and has wide applications in otolith section analysis providing message in a specific life-history period or changes in long periods of time. Otolith annuli, opaque and translucent zones in otolith, relate to fish age due to seasonal variation in the diurnal process of the deposition of the calcareous, crystalline structure and protein matrix. Hence spatial otolith chemistry usually is match to fish age using otolith annuli as temporal references. From the combination of optical and chemical characteristics of fish otoliths, it have been used to reconstruct the sequence of environmental changes experienced by a fish throughout its life and to relate these changes to when they occurred [3]. Here, we analyzed concentration profiles of element impurities in wild Prussian carp otoliths by LA-ICPMS. The periodic distribution of normalized ratios of Mg, Sr, Mn to Ca were appeared along the otolith growth axes. The high value of ratios were corresponding to the opaque zones and the low value corresponding to the translucent ones. A series of experiments were undertaken to verify the consistency of the elemental vibration and otolith annuli with a pair of otolith, different sampling strategy with antero-posterior and dorso-ventral direction, and different otolith with the visible or invisible annuli. These element impurities, distributing in otoliths with periodical fluctuations, can be used for fish age determination and time scale for past environmental reconstructions.

[1] Elsdon *et al.* (2008) *Oceanogr. Mar. Biol. Ann. Rev.* **46**, 297-330. [2] Campana (1999) *Mar. Ecol. Prog. Ser.* **188**, 263-297. [3] Fowler *et al.* (2005) *Mar. Freshwater Res.* **56**, 661-676.