SF	Lithium Isotope Compositions Of Volcanic Arc Lavas: A Study Of Processes And Fluxes In Subduction Zones	
	Lui-Heung Chan, Louisiana State Univ.	
	9/1/99 – 8/31/04	OCE 99-05540

Introduction:

This project is dedicated to fundamental understanding of the processes and source components involved in convergent margin magmatism through a lithium isotope study of the global arc systems. The approach is a systematic characterization of the subduction inputs from marine sediments and the oceanic crust and the output to volcanic arcs. Fig. 1 summarizes the principal results of this project.

Accomplishments:

This project has generated a comprehensive set of Li concentration and isotopic composition data for subducted materials and arc lavas including:

- Ocean crust at ODP 504B and ODP 896A
- Marine sediment at ODP 1039 (Central American Volcanic Arc), ODP 701 (S. Sandwich Arc), ODP 183 (Aleutian Arc), ODP 1027 (Cascades)
- Sediment pore fluids at the Costa Rica subduction zone and the Mariana forearc (ODP 1200)
- Arc lavas from five arc systems

The Li isotope data provide insight to the parameters that control the magma genesis at convergent margins. These controls include:

- Type and amount of the subducted components
- Thermal structure of the subduction zone
- Interaction of slab fluids with the subarc mantle wedge
- Isotopic fractionation during slab metamorphism
- Crustal contamination

The results of this study permit a mass balance consideration of the subduction inputs and the volcanic output of Li and contribute to the understanding of crust-mantle recycling at convergent margins.

The study of pore fluids illuminates the fluid processes at the convergent margins.

Refinement of the thermal ionization mass spectrometric technique for high precision and accuracy analysis of lithium isotopes.

Figures and Captions

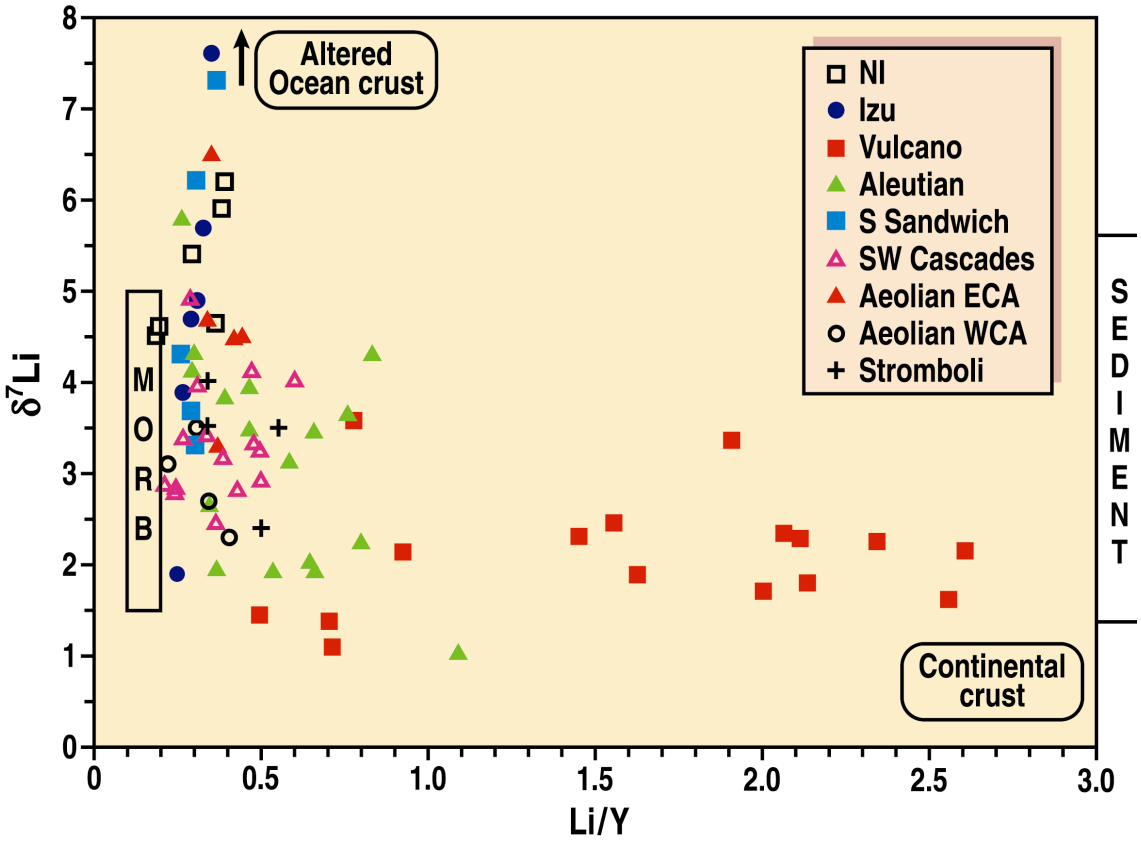

Figure 1: Variation of lithium isotope composition (δ^7Li) of global volcanic arc lavas relative to Y-normalized Li content. The arc systems studied include the South Sandwich Arc, Aleutian Arc, S. Washington Cascades, Central American Volcanic Arc (NI: Nicaragua sector) and Aeolian Arc (ECA: eastern calalkaline, WCA: western calalkaline). Also shown are published data for the Izu Arc (Moriguti and Nakamura, 1998). High δ^7Li of S. Sandwich volcanic arc is attributed to the addition of oceanic crust to the mantle wedge. There is little Li enrichment behind the front of the Cascades Arc and the isotopic composition is MORB-like, suggesting that Li is stripped early from the young and hot crust. Seguam Island of the Aleutian Arc has δ^7Li similar to the range of the local sediments as a result of effective subduction of thick sediments in the Amlia Fracture Zone. The evolved lavas of Vulcano (Aeolian Arc) especially indicate the input from the continental crust.

Publications and Presentations

Presentations:

Kastner M., Morris J., Chan L. H., Saether O., Luckge A., and Silver E. (2000) Three distinct fluid systems at the Costa Rica subduction zone: chemistry, hydrology and fluxes". 11th Annual V. M. Goldschmidt Conference, Oxford, UK. J. Conference Abstracts 5(2) 572.

Leeman W. P., Chan L. H., Tonarini S., and Ferrara G. (2000) Lithium and boron isotopic variations and source components in Aeolian arc lavas. AGU Fall Meeting, EOS, Trans. Amer. Geophys. Union 81, No. 48, F1371.

Chan L. H., Leeman W. P., and Tonarini S. (2001) Lithium isotopic compositions of South Sandwich Arc and Southwest Washington Cascades: A comparative study of arc processes, EOS, Trans. Amer. Geophys. Union 82(47), Fall Meeting Suppl., Abstract V12E-09.

Chan L. H., Leeman W. P., Tonarini S., and Singer B. (2002) Lithium and boron isotopes in the Aleutian Islands: Contributions of marine sediments to island arc magmas. EOS, Trans. Amer. Geophys. Union 83(47), Fall Meeting Suppl., Abstract V61D-11

Savov I. P., Ryan J. G., Chan L. H., D'Antonio M., Mottl M., Fryer P., and ODP Leg 195 Scientific Party (2002) Geochemistry of serpentinites from the S. Chamorro Seamount, ODP Leg 195, Site 1200, Mariana Forearc- Implications for recycling at subduction zones. 12th Annual V. M. Goldschmidt Conference, Davos, Switzerland, Geochim. Cosmochim. Acta 66, A670.

Chan L. H. and Leeman W. P. (2003) Lithium isotopic composition of global arc systems: source components and controls. State of the Arc 2003 Conference, Portland, OR

Chan L. H. (2003) Variation of lithium isotopic composition in terrestrial systems. Key note speech, 13th Annual V. M. Goldschmidt Conference, Kurashiki, Japan. Geochim. Cosmochim. Acta 67, A57.

Papers:

Chan L. H. and Kastner M. (2000) Lithium isotopic compositions of pore fluids and sediments in the Costa Rica subduction zone: implications for fluid processes and sediment contribution to the arc volcanoes. Earth Planet. Sci. Lett. 183, 275-290.

Chan L. H., Leeman W. P. and You C. F. (2002) Lithium isotopic composition of Central American volcanic Arc lavas: implications for modification of subarc mantle by slab-derived fluids. Correction. Chem. Geol. 182, 293-300.

Chan L. H., Alt J. C., and Teagle D. A. H. (2002) Lithium and lithium isotope profiles through the upper oceanic crust: A study of seawater-basalt exchange at ODP sites 504B and 896A, Earth Planet. Sci. Lett. 201, 187-201.

Chan L. H. Mass spectrometric techniques for the determinations of lithium isotopic composition in geological material. Book chapter in Handbook of Stable Isotope

Analytical Techniques, Ed. P. de Groot. (In press).

Clift P.D., Chan L.H., Blusztajn J., Layne G.D., Kastner M., Kelly R.K. (2005) Pulsed subduction accretion and tectonic erosion reconstructed since 2.5 Ma from the tephra record offshore Costa Rica. Geochemistry, Geophysics, Geosystems 6(9), doi:10, 1029/2005GC000963.

Hall, J. M. and Chan, L. H., Li/Ca in multiple species of benthic and planktonic foraminifera: Thermocline and glacial-interglacial changes. Geochim. Cosmochim. Acta. (in press).

Leeman W.P., Tonarini S., Chan L.H., and Borg L.E. (2004) Boron and lithium isotopic variations in a hot subduction zone – the southern Washington Cascades. Chemical Geology 212, 101-124.

Theses:

Zhang L. (2001) Lithium isotope geochemistry of marine sediments. Ph.D. dissertation, Louisiana State University, 141pp.

Hall J. (2002) Barium and lithium in foraminifera: Glacial-interglacial changes in the North Atlantic. Ph.D. thesis, Louisiana State University, 131 pp.