Deciphering crustal evolution from metamorphic and geochemical signatures in calc-silicate gneisses

ISIS FUKAI[1], BARBARA DUTROW[1*], DARRELL HENRY[1], PAUL MUELLER[2] AND DAVID FOSTER[2]

[1]Louisiana State University, Baton Rouge LA, USA (*correspondence: dutrow@lsu.edu)

[2]University of Florida, Gainesville, FL, USA

Field relations, petrographic textures, whole-rock geochemistry, and thermobarometry of calc-silicate gneisses from the Sawtooth Metamorphic Complex (SMC) in central Idaho, USA, preserve details of several important stages of crustal development along the western margin of Laurentia, including: contiguous deposition of a calcareous sandstone-to-marl sequence (Fig 1), peak metamorphism to lower-granulite facies (M1; Fig. 2), followed by widespread deformation at high P-T (D1), an amphibolite-facies thermal overprint (M2), and a late-stage, heterogenous, brittle-ductile mylonitic deformation event (D2). M2 temperature estimates of ~660±40ºC from Hbl-pl thermometry are similar to conditions calculated using Ti-in-biotite (TiB) thermometery and pseudosections, suggesting these methods can be used in calc-silicates to provide useful constraints on metamorphism.

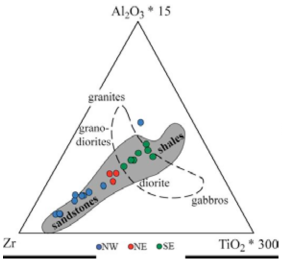

Fig. 1. Calc-silicate whole-rock geochemistry [1]

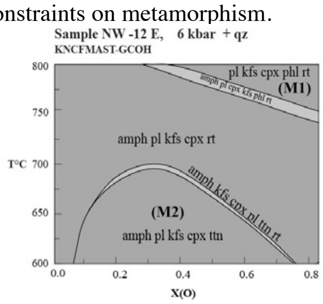

Fig. 2. Calc-silicate T-X(O) pseudosection [2]

The presence of abundant ~1150-1050 Ma Proterozoic detrial zircons in SMC quartzites and quartzofeldspathic gneisses reported in other recent work [3], coupled with protolith compositions near PAUCC, suggests calc-silicate gneisses record continuous sedimentary deposition and multiple metamorphic/deformation events that may be related to the formation/breakup of supercontinent Rodinia. As such, calc-silicates can provide valuable insight into tectonic and metamorphic events in a region.

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Changes in biological pump by ^{230}Th-normalized flux of biogenic components in the Chilean margin sediment during the past 22kyr

M. FUKUDA[1,2]*, N. HARADA[2], M. SATO[1], C. B. LANGE[4], H. KWAKAMI[5], S. PANTOJA[4], T. MATSUMOTO[6] AND I. MOTOYAMA[7]

[1]Univ. of Tsukuba, Tsukuba, Japan, mh_(fukud@geol.tsukuba.ac.jp) (* presenting author)

[2]Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Yokosuka, Japan, haradan@jamstec.go.jp

[4]Univ. de Concepcion, Concepcion, Chile, clange@copas.cl

[5]JAMSTEC, Mutsu, Japan, kawakami@jamstec.go.jp

[6]Univ. of the Ryukyu, Nishihara-cho, Japan, tak@sci.u-ryukyu.ac.jp

[7]Yamagata Univ, Japan, i-motoyama@sci.kj.yamagata-u.ac.jp

During the last glacial maximum, the atmospheric partial pressure of CO_2 (pCO_{2atm}) was very low, 180-190 ppm and rapidly increased to 280 ppm during the last deglacation [1]. During glacial periods, strengthened productivity and an efficient biological pump in the North Pacific, equatorial Pacific, and Southern Oceans may have contributed to low pCO_{2atm}[2]. However, there is still some controversy as to whether marine productivity was high everywhere during glacial periods. To resolve this controversy, more data are required from many regions regarding temporal changes in past export fluxes of biogenic materials. The eastern South Pacific Ocean including the Chilean marginal region, where active biological production is observed at present is target area of this study. The aim of this study is to identify changes in the ^{230}Th-normalized export flux of biogenic components commonly used as proxies for paleoproductivity-namely total organic carbon (TOC), total nitrogen (TN) and biogenic opal (Si_{opal}) from two sediment cores collected at 36°S, off central-south Chilean covering the past 22 kyr (PC-1) and at 52°S near the mouth of Strait of Magellan, Pacific side over the past 13 kyr (PC-3). ^{230}Th-normalized fluxes of biogenic components of sediments at 36°S and 52°S off the Chilean coast imply that the biological pump was effective during 14–8 kyr BP off central Chile, and after 5 kyr BP off central and southernmost Chile; and less effective during 22–14 kyr BP off central Chile and during 13–6 kyr BP off southernmost Patagonia [3]. That is to say, off central Chile, the weakness of the biological pump during the LGM contributed to the global rise of pCO_{2atm} at that time. During 14–8 kyr BP, the increasing effectiveness of the biological pump at the PC-1 site off central Chile contributed to the global rise of pCO_{2atm}. At the PC-3 site, the weakening of biological pump contributed to the rise of pCO_{2atm} during 13–6 kyr BP. After 6 kyr BP, the active biological pump did not contribute to the rise of $pCO_{2atm.}$ In this presentation, we will also report ^{230}Th-normalized fluxes of biogenic components at the 55°S collected from the Drake Passage sediment.

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