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Stable C and O isotope ranges of African land snail shell refrect different ecosystems

Yoshihiro Sawada[1*], David Dettman[2], Martin Pickford[3]

[1]Professor Emeritus, Shimane University, [2]Geoscience Department, University of Arizona, [3]Museum National d'Histoire Naturelle, France

The geochemistry of land snail shell can be a good indicator of paleoenvironmental conditions, because it responds to seasonal environmental variation encountered by the animal and fossil land snails can be found in many continental sections. We present variation in the stable C and O isotope ratios of modern land snail shell from various ecosystems in the African continent and discuss the relationships between ranges of isotope ratios, genus, climate, and diet.

Sequential powdered samples from shells are drilled parallel to growth lines through multiple years of shell growth. Results are summarized as follows:

d13C: Variation within one specimen is small. The values probably respond to differences in diet, i.e. C3 plants, C4 plants, and the ingestion of carbonates from detritus, bedrock or soil.

d18O: (1) The ranges in oxygen isotope ratio from tropical forest, upland forest, desert, semi-desert are small, with the values of the former two generally lower than desert or semi-desert. (2) Regions with pronounced dry and wet seasonality (savanna, and some Mediterranean) show large seasonal variation in d18O. Within one climate class, snails of different genus sometimes have similar ranges, and sometimes different ranges. Habitat climate has a stronger control on shell chemistry than taxonomy. For example, oxygen isotope ratios of Achatina from savannah woodland, Pakasi, Kenya are +5.4 to -5.4 per mil, while Achatina from a Tropical forest, Pemba Island, Tanzania are +0.1 to -2.8 per mil.

We conclude that the d13C and d18O ranges of land snail shells reflect ecosystems, diet, and perhaps micro-habitat preference, and that land snail fossils are good indicators for paleoenvironment and palaeoclimate based on a combination of faunal analysis and C and O stable isotope geochemistry.

[Tropical forest] Leptocala (Lastourville, Gabon) d13C:-11.28 ~ -13.28; d18O: -0.97 ~ -3.29; Trochnanina (Lastouvilla, Gabon) d13C: -14.20 ~ -15.56; d18O: +0.39 ~ -1.74; Thapsia (Lastouvilla, Gabon) d13C: -11.80 ~ -13.35; d18O: -1.37 ~ -3.55; Limicolaria (Mabira forest, Uganda) d13C: -12.68 ~ -15.36; d18O: +1.01 ~ -3.85; Achatina (Pemba Island, Tanzania) d13C: -8.45 ~ -13.02; d18O: +0.13 ~ -2.83

[Upland forest] Limicolaria (Kipsaraman, Kenya) d13C: -9.37 ~ -11.41; d18O: +1.41 ~ -2.13; d18O: Limicolaria (Alekilek, Uganda) d13C: -9.01 ~ -12.11; d18O: +2.61 ~ -0.82

[Upland woodland] Limicolaria (Napak, Uganda) d13C: -7.90 ~ -10.02; d18O: +3.45 ~ -0.07; Trochnanina (Napak, Uganda) d13C: -0.24 ~ -5.22; d18O: +1.63 ~ -1.25; Limicolaria (Koru, Kenya) d13C: -8.35 ~ -12.33; d18O: +2.03 ~ -2.23

[Savannah woodland] Xeroceratus (Aigamas, Namibia) d13C: -6.37 ~ -7.99; d18O:-2.31 ~ -7.76; Achatina (Pakasi, Kenya) d13C: -5.96 ~ -10.90; d18O: +5.38 ~ -5.42

[Mediterranean (winter rain fall)] Helicopsis (Agadir, Morocco) d13C: -3.19 ~ -4.62; d18O: +0.74 ~ -0.99; Rumia (Agadir, Morocco) d13C: -9.27~ -9.80; d18O: +5.76 ~ -1.08; Kabylia (Agadir, Morocco) d13C: -5.31 ~ -7.01; d18O: +3.48 ~ -0.07

[Semi-desert] Dorcasia (Remhoogte, Namibia) d13C: -5.91 ~ -8.58; d18O: +3.89 ~ -0.12; Bloyetia (Kogole, Uganda) d13C: -5.96 ~ -7.32; d18O: +2.79 ~ -1.21

[Desert] Dorcasia (Skilpadberg, Namibia) d13C: -0.18 ~ -1.03; d18O: +3.37 ~ 1.26; d18O: Trigonephrus (Bogenfels, Namibia) d13C: -0.20 ~ -2.75; d18O: +5.70 ~ 3.27

This work continues with future analysis of stable isotopes in land snails from following ecosystems; savannah woodland near Lake Albert; semi-arid woodland steppe, Uganda; savannah bushland, Kenya; coastal steppe, Oman; and desert, Namibia

Keywords: paleoenvironment, paleoclimate, land snail, carbon isotopes, oxygen isotopes, Africa