

Domestication patterns of pigs (*Sus scrofa*) evidenced by carbon and nitrogen isotope analysis for prehistoric boar bone collagen

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Wild boar (*Sus scrofa*) might change the diet from natural resources to agricultural products or leftovers of human diet during the initial step of pig domestication. We have analyzed stable carbon and nitrogen isotopes of boar bone collagen to evidence this hypothesis in the Far East. Boar bones from archaeological sites at Ryukyu and other islands in Japan archipelago were analysed and compared with the results in Korea, Taiwan and Vietnam. Carbon and nitrogen isotope compositions in boar bone collagen from sites (ca. 4000BP) in central Japan showed a nearly similar range ($\delta^{13}\text{C} = -21 \pm 1\%$ and $\delta^{15}\text{N} = 4 \pm 2\%$) with that of deer in Japan, suggesting that the herbivores fed mainly on C_3 plants in natural system. However, boar from Ryukyu showed unusually higher $\delta^{15}\text{N}$, often increased to 12 ‰, although no change occurred in $\delta^{13}\text{C}$, strongly suggesting a significant contribution of animal diets. Such ^{15}N enrichment was already found in the early Jomon period (ca. 6000BP) in Ryukyu. In contrast, some boar from Ie island (ca. AD 2-3C), and historic pigs from both Ryukyu and east coast of Korea (Kan-wongdou: AD 1C) showed significant enrichment of ^{13}C , indicating much contribution of C_4 plants or marine foods. We concluded that at least three feeding patterns were developed in domestication around the East China Sea. One pattern is mainly based on consumption of human leftovers, clearly marked by high $\delta^{15}\text{N}$ indicating similarity with humans. The second is a system feeding C_4 millets, although the degree of dependence on agricultural products should be variable according to the case. The third pattern is the feeding of marine resources. We suggest that boar found in early sites in Ryukyu might be the first pattern and were imported probably from main lands prevailing rice agriculture. While later sites showed the second pattern using millet products and seems to spread as popular domestication in the Ryukyus. Unreasonably domestication based on the marine resources might not be established in the Ryukyu archipelago.

$^{87}\text{Sr}/^{86}\text{Sr}$ ratios in lake sediments in Lake Biwa, Japan — Environmental change in the last 200 years

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Lake Biwa is the largest lake of Japan and one of a few ancient lakes. The area surrounding the southern basin has many overpopulated cities, and has recently become polluted by remarkably increased human activities. In this study, three sediment cores from the northern basin, the southern basin and the boundary part of the basins were analysed for $^{87}\text{Sr}/^{86}\text{Sr}$ ratio and major and minor element compositions in order to study spatial variability and environmental change in the last 200 years.

Core samples were dried, pulverized and analysed for major element compositions by XRF. An aliquot of the sample was leached with 2M HCl to remove carbonates. The samples were digested with HF-HClO₄ and separated Sr and Rb using AG50WX8 cation-exchange-resin column. $^{87}\text{Sr}/^{86}\text{Sr}$ ratios were analyzed using Micromass Sector 54-30 mass spectrometer. Quantitative analyses of Rb and Sr were done by the isotope dilution method using Finnigan MAT THQ mass spectrometer. The sedimentation rate of the lake sediments was estimated by ^{210}Pb and ^{137}Cs .

$^{87}\text{Sr}/^{86}\text{Sr}$ ratios of sediment cores in the southern basin are 0.7200 and radically decrease to 0.7184 at the depth of 10cm layer, deposited in approximately 1960, and show the low value within the surface layer. The Sr and Ca concentrations increase rapidly within the same depth layer, while Rb concentration is unchanged. The sediment cores in the northern basin have higher $^{87}\text{Sr}/^{86}\text{Sr}$ ratios (0.7210) and a little decrease at the 10cm depth layer, and show no increase in Sr concentration at the surface layer. The $^{87}\text{Sr}/^{86}\text{Sr}$ ratio profile from the boundary part of the basins shows an intermediate trend between the profiles in the southern sediments and northern sediments.

The residue after HCl-leaching for the southern sediments shows the high $^{87}\text{Sr}/^{86}\text{Sr}$ value similar to that of the northern sediments. The result suggests that the sediments in the southern basin and northern basin have originated from the same clastic components, and that an addition of any material with low Sr isotopic ratio to the surface layer in the sediments in the southern basin. Artificial activities might produce a large effect on Sr in lake sediments in the south basin. The surface sediments in the southern basin, however, could be disturbed and mixed by biological/physical turbulence because the southern lake is shallow.