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# Tracing environmental processes using long-lived radionuclides in Xi'an AMS Center

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A series of analytical methods have been developed for sensitive and accurate determination of long-lived 129I, 14C, plutonium and uranium isotopes in various environmental samples, such as soil, sediment, water, air, and vegetation samples in the Xi'an AMS center using the 3MV tandem AMS, MICDAS AMS and other mass spectrometry methods. An overall investigation of artificial radioactivity in terrestrial and the adjunct sea environment of China has been implemented in the past 15 year to obtain their distribution and sources, in order to understand their dispersion and transfer pathways and environmental impact. In general, a relative higher level of anthropogenic radionuclides, e.g. 129I, 239, 240Pu, were observed in North China compared to South China. No significantly enhanced levels of anthropogenic radionuclides were observed in the surrounding area of Lop Nor nuclear weapons testing sites (300-600 km distance to the center of the testing site) were measured, due to the desert and hard bed of dried salt lake topography and geography in Lop Nor region. The measured 240Pu/239Pu atomic ratios in all environmental samples except a few samples from northeast Xinjiang were around 0.16-0.20, which are similar to the ratio of the global fallout of atmospheric nuclear weapons tests (0.18), indicating most of the plutonium and many other anthropogenic radionuclides originated from global fallout. Significantly lower 240Pu/239Pu ratios of 0.11-0.13 were observed in soil samples collected from northeast corner of Xinjiang, this might result from the transport of the close-in deposition of Semipalatinsk nuclear weapons tests in 1950-1963.

The 129I and Pu isotope level in the surface soil shows a gradually declined trend from North to South China, and relative higher level were observed in North China, especially in the eastern inner Mongolia at the west side of the Greater Khingan Mountains and Yinshan Mountains, this is attributed to the long-distance transport of gaseous 129I by dominant westerlies wind in this region from Europe, where large amount of 129I was discharged to the seas and atmosphere from Sellafield and La Hague spent fuel reprocessing plants. The mountain topography and climate condition in the eastern Inner Mongolia promoted the deposition and retention of 129I in the region. These hypotheses were confirmed by the measured distribution of 129I in the sediment cores collected from Jiaozhou Bay, East China Sea and Tal lake in Philippine, which showed constantly higher level of 129I in the upper layer sediment (after 1980), and the decreased inventory of 129I in the sediment core from north location to south location in Asia (Fan et al. 2016; Zhang et al. 2019; Zhao et al. 2021a, b). The declined 129I level from North to South China resulted from the transport of reprocessing derived 129I dispersed to North China to South Asia by East Asia winter monsoon.

The level of 129I in the China Sea shows a higher concentration in the north (Yellow Sea and Bohai) compared to the south (East China Sea and South China Sea). Meanwhile a high 129I/127I atomic ratios in the coastal seawater, especially the estuarine seawater were much higher than the open seawater, and in the surface seawater compared to the deep water. The 129I/127I atomic ratios in seawater is much lower than that in river or lake water. The high 129I in the estuarine and costal water is attributed to the terrestrial input of 129I through rivers by leaching and transport of 129I deposited in on the land, and the high deposition of 129I in North China compared to South China. A significantly increased 240Pu/239Pu ratios (0.25-0.35) was observed in the seawater and sediment in the China Seas, clearly showing the contribution of the continuous resuspension of radioactive substance in the PPG nuclear weapons tests site and its long-distance transport through the North Equator and Kuroshio Currents. A remarkable Fukushima 137Cs signal was observed in the South China Sea and West Pacific Ocean, especially in the middle and subsurface layer, which was transported to this region from Fukushima through a long-distance transport via water circulation.

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## Student Submission

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