Thermionic valves and Ar-Ar dating

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John Reynolds was inspired to construct the first ultra high vacuum static mass spectrometer after attending a seminar in 1950 given by Daniel Alpert co-inventer of the Bayard-Alpert ion gauge. Reynolds realised how the vacuum techniques described, for the manufacture of thermionic valves, could be adapted to mass spectrometry, eliminating the inefficient and wasteful loss of sample in the dynamic mass spectrometers then in use. In the 1960s Berkeley became the focus of this new technology and ideas; the discovery of extinct ^{129}I was followed by the use of neutron activation to establish ^{129}Xe-^{127}I correlations and the idea of I-Xe dating. Although xenon was the prime interest, the routine of measuring all five noble gases led to the ^{40}Ar-^{39}Ar dating method and the ability to identify and quantify theoretically the effects of disturbed K-Ar systematics. Interestingly the use of neutron activation to produce a 'solid' ^{39}Ar spike for use in K-Ar dating had been suggested in a paper by Naughton in 1963 and recently this method, along with a ^{41}K spike, has been proposed independently by Ken Farley as a way to measure accurate K-Ar ages remotely on the surface of Mars. The production of ^{37}Ar from Ca is conveniently used in extraterrestrial samples to determine cosmic ray exposure ages. In principle this could be applied to terrestrial samples but within severe analytical constraints. The ability to analyse chlorine, bromine and iodine by way of neutron produced ^{38}Ar, ^{80,82}Kr and ^{128}Xe is especially useful given the importance of saline fluids as a transport medium of various species, including noble gases, within the Earth's crust. The argon-chlorine link can also provide a solution to the 'excess' ^{40}Ar problem. Most recently ^{36}Ar in sodalite in the Allende meteorite has provided further evidence of an extinct nuclide, ^{36}Cl.