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CaF₃⁻/KF₃⁻ on-line separation methods and the present ⁴¹Ca/Ca sensitivity at AEL-AMS

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The use of ⁴¹Ca as a sensitive long-period tracer for osteoporosis diagnoses is made possible by accelerator mass spectrometry (AMS), with which CaF₃⁻ ions are produced and the resulting MeV positive ⁴¹Ca ions are counted. When the ion energy is sufficiently high, ⁴¹Ca and its interfering isobar ⁴¹K can be well separated by their dE/dx differences in the final ionization detector. Such applications to the populace at large, however, still await the creation of efficient small (<1MV) AMS systems that can still have a sufficiently high abundance sensitivity (⁴¹Ca/Ca ~ 1e-13 or better). At present, small AMS systems do not have effective means to separate ⁴¹Ca from ⁴¹K on-line. Two potential methods have been explored in Canada, one exploits the molecular binding differences in CaF₃⁻ and KF₃⁻, and the other exploits the yield differences when CaF₃⁻ and KF₃⁻ are partially fragmented into CaF⁺ and KF⁺. While these are being further developed at Lalonde AMS of uOttawa, its existing capability for ⁴¹Ca analysis using the AMS system as is, has also been determined. The ⁴¹Ca/Ca abundance sensitivity using the straightforward fast sequential injection technique between ⁴¹CaF₃⁻ and ⁴⁰CaF₃⁻, is found to be ≤ 5e-13 with the 3MV tandem accelerator running at its designed upper voltage limit. This is already adequate for supporting ⁴¹Ca medical research at the new and presently the only AMS facility in Canada.

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