



Preparation of $^{95m,g}\text{Tc}$, ^{96}Tc by irradiation of Mo with alpha-particles and deuterons

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Accelerator facilities

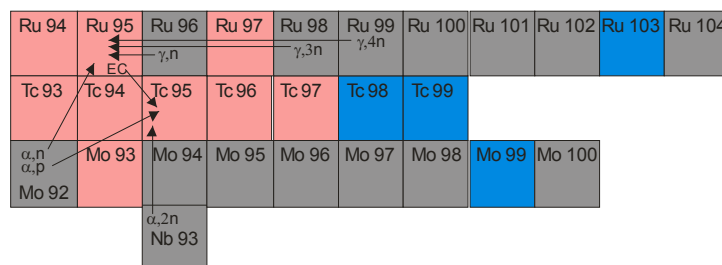
- 120-cm cyclotron of SINP MSU, 7.5 MeV/nucleon, α -particles, deuterons, protons.
- Race-track microtron, bremsstrahlung photons up to 70 MeV

Radiotracers for ^{99}Tc analysis

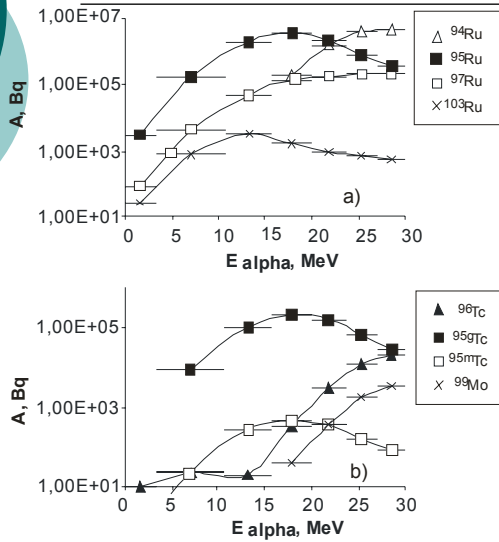
- $^{99\text{m}}\text{Tc}$ (6 h) is commonly used, but its short half-life complicates the analysis.
- Another tracer – $^{95\text{m}}\text{Tc}$ (61 d) has relatively long half-life and interfere in determination of ^{99}Tc registering β -particles.
- It is suggested to apply $^{95\text{g}}\text{Tc}$ (20 h) and ^{96}Tc (4,3 d), with optimal half-life.

Production $^{95\text{g}}\text{Tc}$ via ^{95}Ru

- All nuclear reactions on Mo and Nb result in mixture of isomers whereas ^{95}Ru decays mostly to $^{95\text{g}}\text{Tc}$

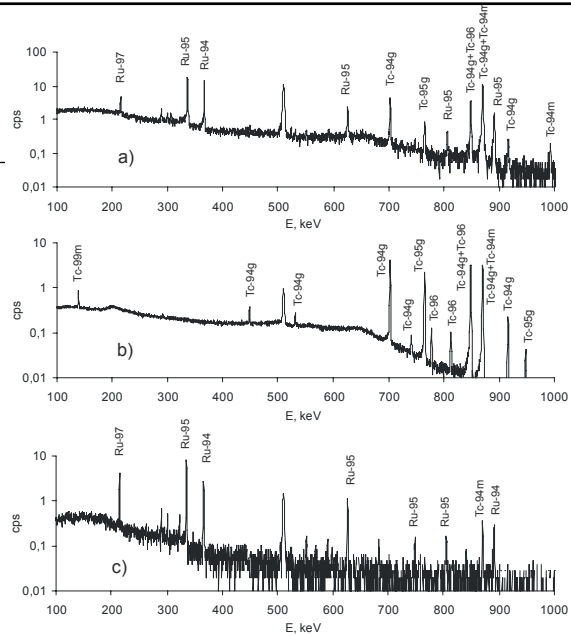


Depth distribution of radionuclides in ^{nat}Mo target



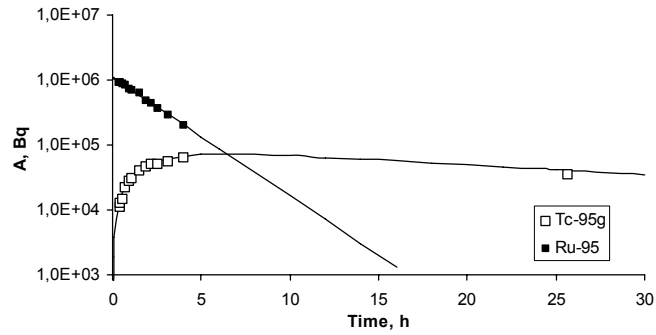
Target – stack of 8 Mo foils
25 um each
15 min, 1 uA, ⁹⁵Tc corrected
1 d after EOB

LLX

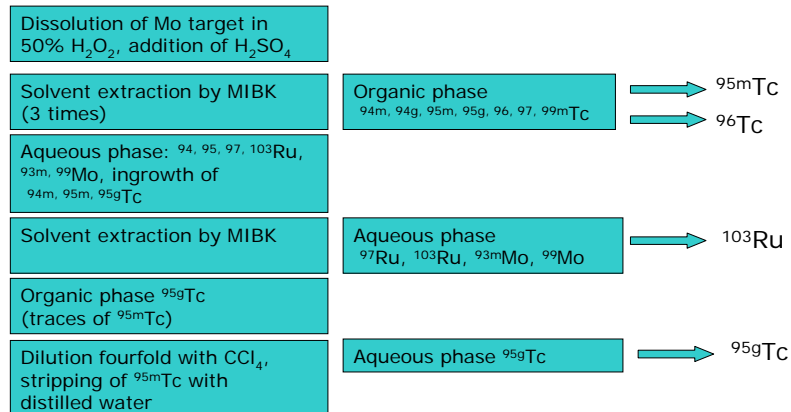


Gamma spectra of irradiated target (a), organic (b) and aquatic (c) phases after first separation

Decay of ^{95}Ru and ingrowth of ^{95g}Tc



Flow-chart of ^{95g}Tc production



Yield of products

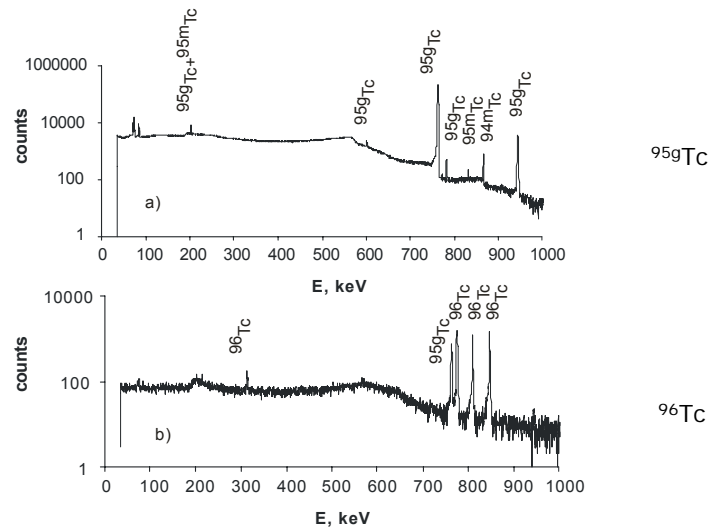
- ^{95g}Tc separated from foils # 3-5 of stack Mo target, (24→11 MeV), ^{103}Ru and ^{95m}Tc form as side products and may be utilized
- ^{96}Tc may be separated from foil # 1 (30→27 MeV)
- Irradiation of natural molybdenum stack foil target for 15 min with α -particle beam (1 μA) yields 140 kBq of ^{95g}Tc , 9 kBq of ^{96}Tc and 0,5 kBq of ^{95m}Tc .

Radionuclidic purity of $^{95g}\text{Tc}^*$

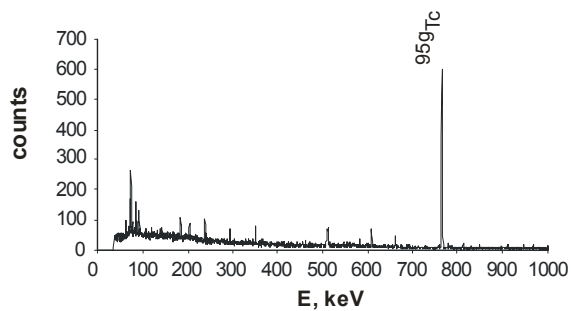
Method of ^{95g}Tc production	$^{95m}\text{Tc}/^{95g}\text{Tc}$, %	$^{96}\text{Tc}/^{95g}\text{Tc}$, %
$^{95}\text{Ru} \rightarrow ^{95g}\text{Tc}$	$9.1 \cdot 10^{-2}$	$1.1 \cdot 10^{-3}$
natMo α irradiation (thick target)	$2.3 \cdot 10^{-1}$	5.4
^{93}Nb α irradiation (thick target)	$4.1 \cdot 10^{-1}$	12.3
^{93}Nb α irradiation (30→27 MeV)	$3.2 \cdot 10^{-1}$	1.1

* All data corrected 1 d after EOB

Gamma-ray spectra of ^{95g}Tc and ^{96}Tc separated from the same target



Alternative method: photonuclear reaction

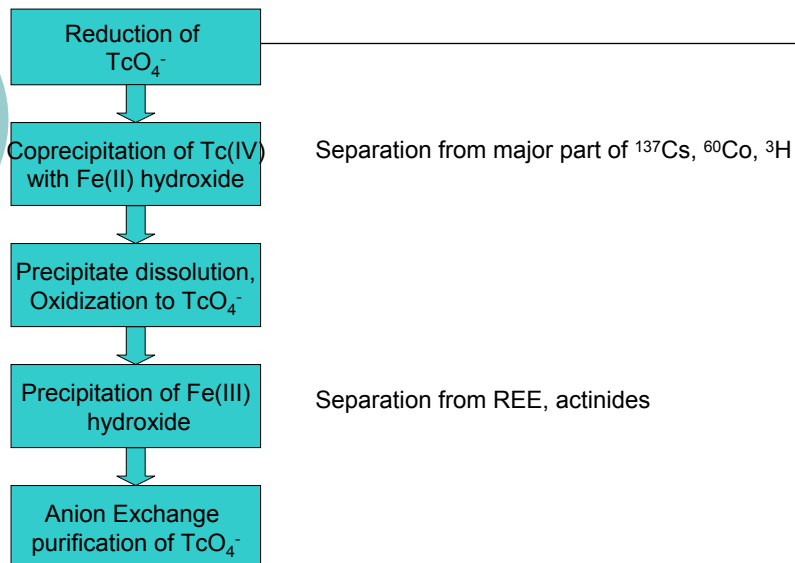


Gamma-ray spectra of ^{95g}Tc separated from $^{\text{nat}}\text{RuCl}_4$ solution, irradiated by 70 MeV photons

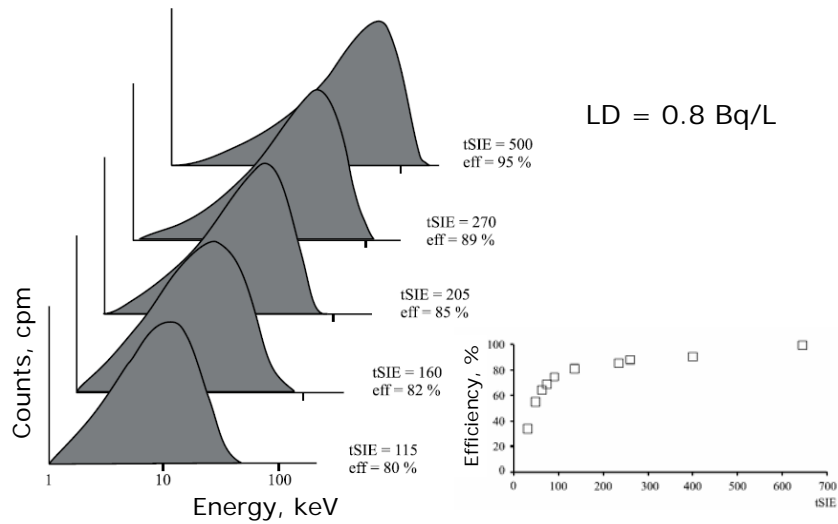
Application for analysis

- Application of ^{95}Tc as a tracer simplifies analysis of ^{99}Tc , decreases LD.
- Analysis of hundreds samples from Mayak facility, ^{99}Tc migration monitoring in underground waters in the South Ural region

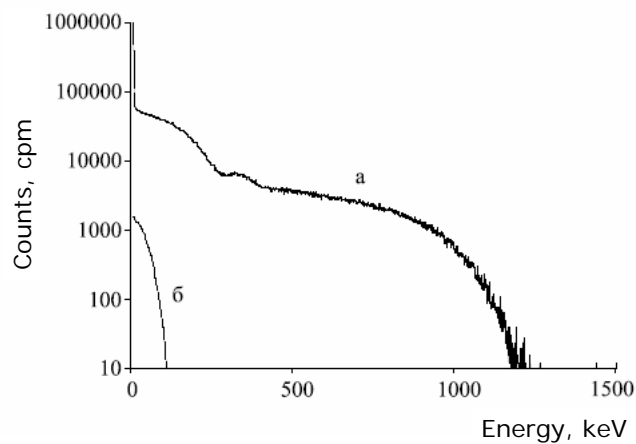
^{99}Tc analysis specially developed for highly contaminated water samples



LSC determination of ^{99}Tc – quenching calibration



LS spectra of contaminated water sample before (a) and after (b) separation of ^{99}Tc



⁹⁹Tc in industrial water reservoirs (Mayak)



B-9
(Karachaj lake)
20,5 kBq/l



Aliev R., Kalmykov S., Tananaev I. et al.

B-17
(“Old Swamp”)
5,7 kBq/l

