Introduction to the CAMECA IMS 7f-GEO

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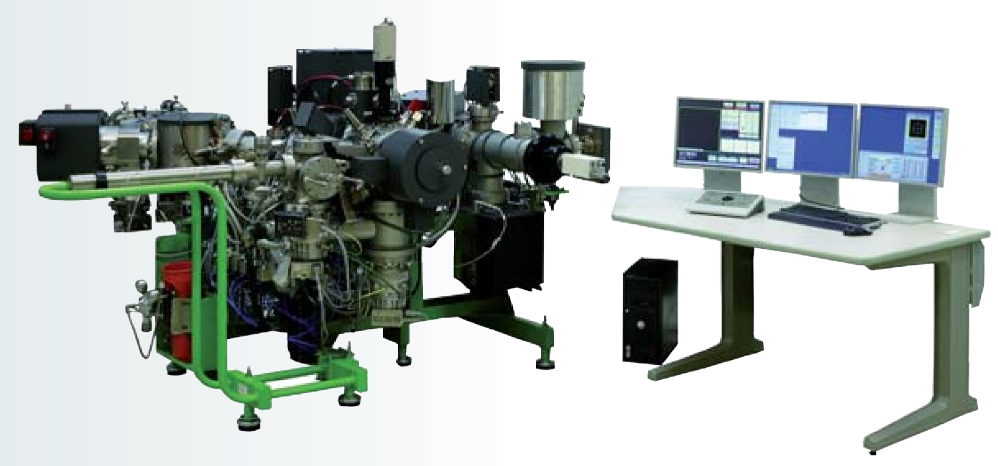
Introduction

SIMS technique benefits for Geosciences

- In-situ analysis (any polished surface)
- High spatial resolution
- Large application range (from H to U)



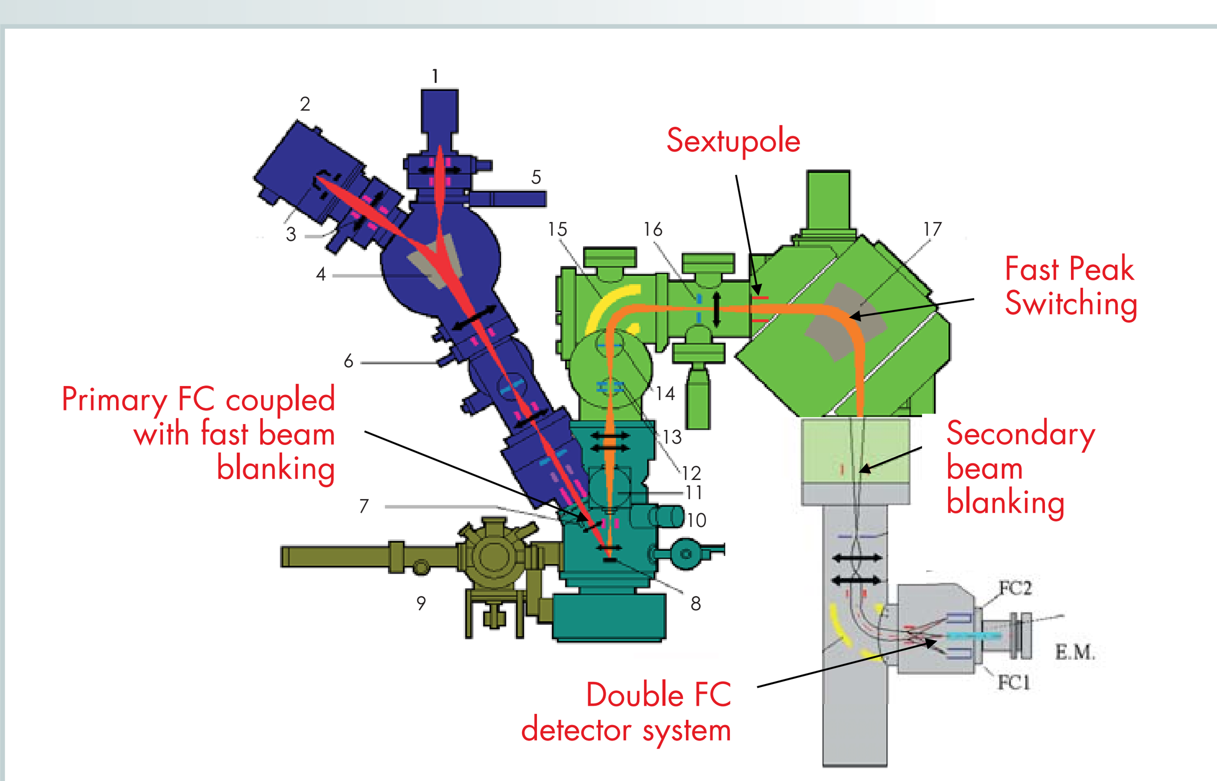
Two types of CAMECA instrumentation

- Large mass spectrometer with multicollection system (IMS 1280, NS50) –> full application range in Geosciences
- Compact mass spectrometer and monocollection system (IMS 7f-GEO) –> limited application range in Geosciences

For high precision isotope ratio measurements

- FCs are preferred to EMs provided that secondary ion intensities are strong enough
- When parallel detection is not available
  - Primary beam intensity monitoring during analysis provides benefits in terms of measurement precision (by minimizing short term instrument stability effects)
  - Fast mass peak switching provides benefits in terms of analysis throughput

The IMS 7f-GEO has been designed to meet with these instrumental performance requirements.



IMS 7f-GEO Features

Quasi-continuous primary beam intensity monitoring

- Combination of a fast beam blanking and a Faraday cup equipped with repeller and running in charge mode
- For every elementary acquisition (80ms) a given percentage (software controlled) is dedicated to the primary intensity (Ip) measurement
- One Ip value returned per data point

Sextupole at the entrance of the magnet

- 2nd order aberration cancellation allowing the use of a larger field aperture @ constant MRP
- Provides higher instrument transmission at HMRP

Fast mass peak switching system

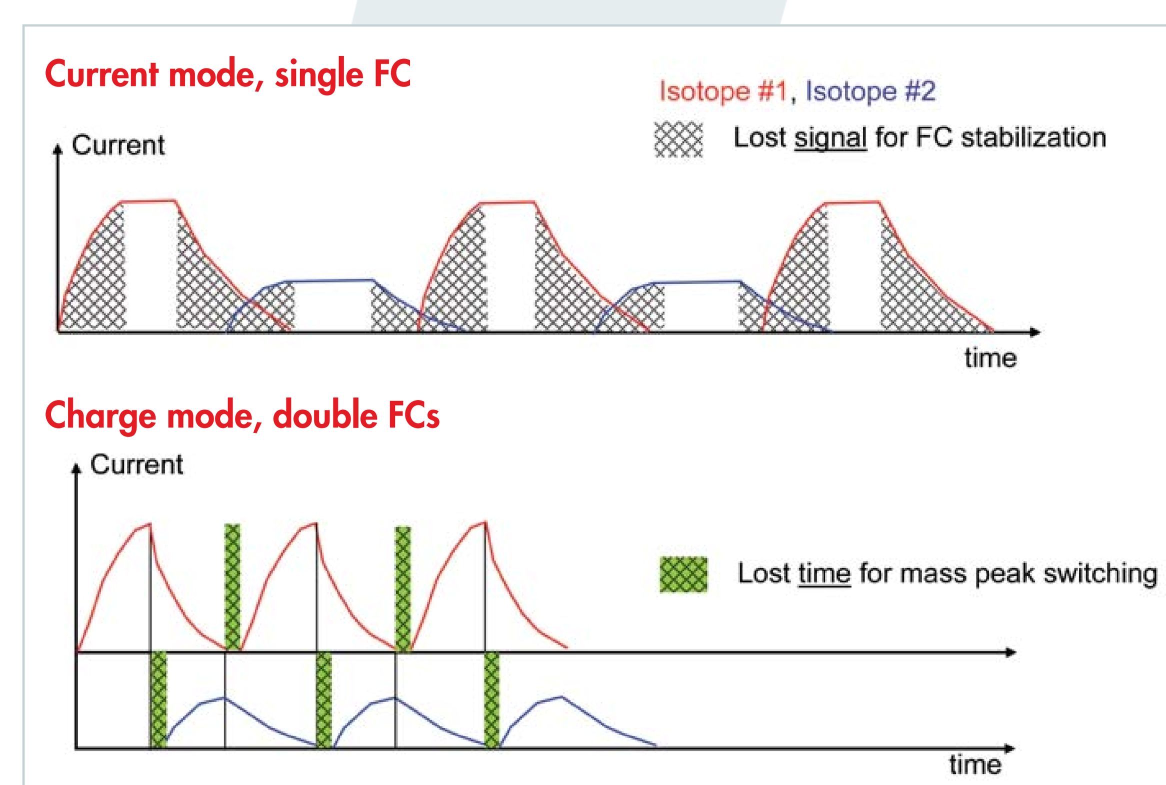
- Combination of magnetic & electrostatic beam deflection
- During a mass jump the Hall probe measures the B field. The Hall probe signal is used to apply an electrostatic voltage feedback on the magnet flight tube. This voltage rapidly deflects the secondary beam and therefore allows to speed up the peak positioning in the exit slit plane.
- As fast as 0.3 sec at HMRP
- Applicable over the full mass range (compatible with REE analysis)

Secondary beam blanking system

- Allows to control exactly the time the secondary beam is addressed into a given FC channel

Double Faraday cup system

- 2 Faraday cups and 2 FC acquisition channels are implemented
- Can accommodate two different resistors (e.g. 10^{10} Ω for ^{16}O and 10^{11}Ω for ^{18}O)
- FCs running in charge mode: no need for FC settling time between two isotopes



Example : $^{18}O/^{16}O$ analysis

- Primary beam control precision: 1‰
- Analysis required precision: 0.4‰
- ^{18}O signal intensity: ~2e6c/s

Mode	Requested measurement time
EM/EM	3016 sec.
FC/FC (charge mode)	56 sec.

Applications

REE Analysis

- O^-, positive secondary ions
- Analysis area size ~20x20µm²
- Low mass resolution
- Energy filtering technique
- Detection: $^{28}Si^+$ on FC2 (R=1e11Ω) all other species on EM

Sample: NBS 610
Internal error vs. Poisson statistics for one spot:

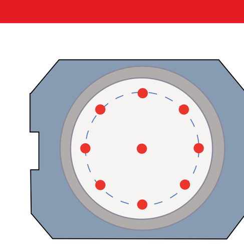
Ratio	139La/Si	140Ce/Si	141Pr/Si	143Nd/Si	149Sm/Si
Mean	7.15E-04	6.18E-04	7.45E-04	9.12E-05	1.14E-04
Std. err %	0.14	0.12	0.13	0.12	0.15
Poisson %	0.11	0.12	0.11	0.22	0.20

	151Eu/Si	156/Si	157Gd/Si	159Tb/Si	161Dy/Si
	3.97E-04	2.82E-04	2.42E-04	6.96E-04	1.35E-04
	0.12	0.22	0.24	0.07	0.21
	0.15	0.18	0.14	0.12	0.18

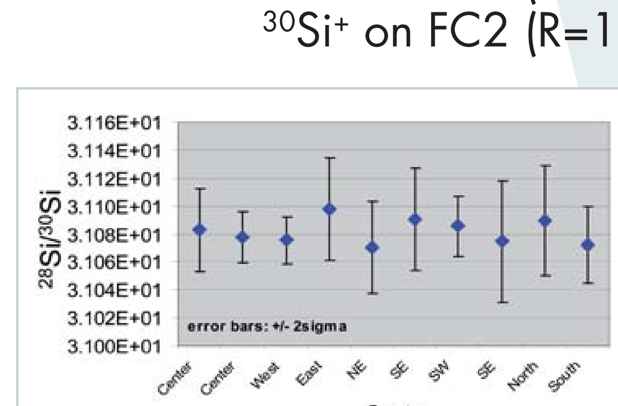
	165Ho/Si	167Er/Si	169Tm/Si	172Yb/Si	175Lu/Si
	6.68E-04	1.65E-04	6.31E-04	1.49E-04	5.54E-04
	0.14	0.11	0.15	0.22	0.13
	0.12	0.17	0.12	0.18	0.13

Silicon isotopes

Sample: Si quartz disk
10 spots within 15mm in Ø



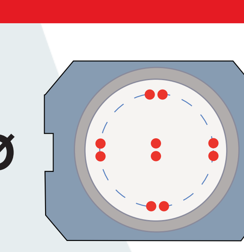
- O^-, positive secondary ions
- Analysis area size ~15x15µm²
- High mass resolution
- Detection: $^{28}Si^+$ on FC1 (R=1e10Ω)
  $^{30}Si^+$ on FC2 (R=1e11Ω)



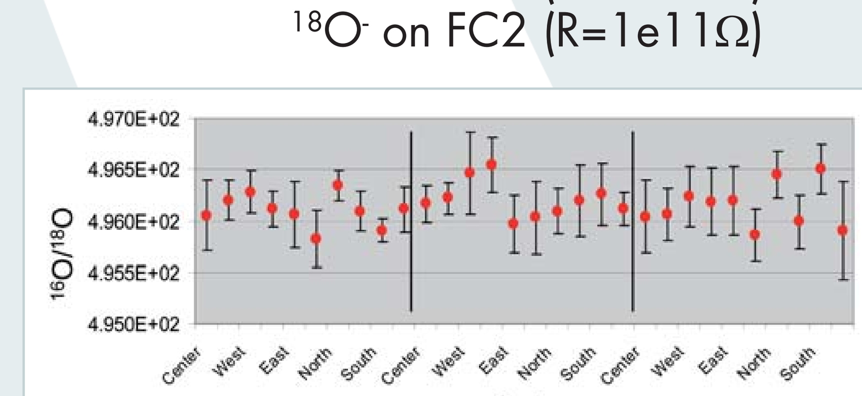
- $^{28}Si/^{30}Si$ ratio:
  - I($^{30}Si^+$) ~2e6c/s
  - Expected counting statistics for a total integration time of 56s: 0.04%
  - Experimental Std. dev. over 10 spots: 0.03%

Oxygen isotopes

Sample: Si quartz disk
3 series of 10 spots within 15mm in Ø



- Cs^+, negative secondary ions
- Analysis area size ~15x15µm²
- High mass resolution
- Detection: $^{16}O^-$ on FC1 (R=1e10Ω)
  $^{18}O^-$ on FC2 (R=1e11Ω)



- $^{16}O/^{18}O$ ratio:
  - I($^{18}O^-$) ~2e6c/s
  - Expected counting statistics for a total integration time of 56s: 0.04%
  - Experimental Std. dev. over 3 series of 10 spots: 0.04%