

Contents

Acknowledgement	(i)
Contents	(iii)
List of Tables	(v)
List of Figures	(vi)
1 Introduction	1
1.1 Ca-Al-Rich Inclusions (CAIs)	3
1.2 Isotopic Studies of CAIs	5
1.2.1 Studies of Stable Isotope Anomalies	6
1.2.2 Mg Isotopic Studies	7
1.3 Extinct Radionuclides as "Chronometers" of Early Solar System Processes . .	10
1.4 Aim and Scope of this work	11
2 Experimental Techniques	14
2.1 The Cameca Ims-4f Ion Microprobe	14
2.1.1 Primary Ion Column	16
2.1.2 Secondary Ion Column	18
2.2 High Mass Resolution Isotopic Analysis	22
2.2.1 Interferences and Corrections	23
2.2.2 Dynamic Stability of the Instrument	23
2.2.3 Stability of the Counting System	27
2.3 Isotopic Analysis of Terrestrial Standards	29
2.3.1 Mass Fractionation	29
2.3.2 Mg Isotopic Analysis	34
2.3.3 K-Ca Isotopic Analysis	38

3	Sample Description	43
3.1	Efremovka CAIs	43
3.2	Grosnaja CAIs	45
4	Results	61
4.1	Results from Mg-Al Isotopic Studies	61
4.2	Results from K-Ca Isotopic Studies	78
5	Discussion	83
5.1	Processes Affecting the Formation of CAIs	84
5.2	Relict Spinel and Nebular Environment for the Formation of CAIs	91
5.3	Mg-Al Isotopic Systematics and Isotopic Heterogeneity in the Nebula	99
5.4	^{41}Ca In The Early Solar System	105
5.5	Extinct Radionuclides and Time Scales for Early Solar System Process	110
6	Summary and Conclusions	114
6.1	Scope for Future Work	117
7	References	120
8	List of Publications	129