

## TOP TEN COMPANIES IN RARE EARTHS



**AVM090A**  
**January 2013**

Anna Welch Crull  
***Project Analyst***

ISBN: 0-89336-794-X

**bcc** | Research  
Market Forecasting

**BCC Research**  
**49 Walnut Park, Building 2**  
**Wellesley, MA 02481**  
**866-285-7215, 781-489-7301**  
**www.bccresearch.com**  
**Custom Reports: carol.laverty@bccresearch.com**

**TABLE OF CONTENTS**

<b>TOPIC</b>	<b>PAGE NO.</b>
CHAPTER 1 INTRODUCTION	1
STUDY GOALS AND OBJECTIVES	1
REASONS FOR DOING THIS STUDY	1
INTENDED AUDIENCE	1
METHODOLOGY AND INFORMATION SOURCES	2
RELATED BCC RESEARCH STUDIES	2
CUSTOM ANALYSES	3
ANALYST CREDENTIALS	3
BCC ON-LINE SERVICES	3
DISCLAIMER	4
CHAPTER 2 SUMMARY	6
<i>SUMMARY TABLE GLOBAL MARKET FOR RARE EARTHS, THROUGH 2016 (METRIC TONS <math>\hat{a}</math> REO EQUIVALENT)</i>	7
<i>SUMMARY FIGURE GLOBAL MARKET FOR RARE EARTHS, 2009-2016 (METRIC TONS – REO EQUIVALENT)</i>	7
CHAPTER 3 OVERVIEW	10
RARE EARTH ELEMENTS	10
<i>FIGURE 1 RARE EARTHS IN THE PERIODIC CHART</i>	10
<i>TABLE 1 TYPICAL PROPERTIES OF LANTHANOIDS</i>	12
RARE EARTH MINERALS	13
<i>TABLE 2 TYPICAL RARE EARTH CONTENT IN SELECTED RARE EARTH MINERALS (RARE EARTH OXIDE [REO] %)</i>	13
RARE EARTHS PROCESSING	14
<i>TABLE 3 PROCESSING STEPS IN THE RARE EARTH INDUSTRY</i>	15
HOW RARE IS RARE?	15
CHAPTER 4 APPLICATIONS AND USES FOR RARE EARTH ELEMENTS	18
END USES	18
METALLURGICAL/MECHANICAL	19
<i>TABLE 4 RARE EARTH ELEMENTS APPLICATIONS IN THE METALLURGICAL AND MECHANICAL SECTOR</i>	19
GLASS/CERAMICS	20
<i>TABLE 5 RARE EARTH APPLICATIONS IN THE GLASS/CERAMIC SECTOR</i>	21
ELECTRONICS, OPTICS AND OPTOELECTRONICS	21
<i>TABLE 6 RARE EARTH APPLICATIONS IN ELECTRONICS, OPTICS AND OPTOELECTRONICS</i>	22
CHEMICAL	23
<i>TABLE 7 RARE EARTH APPLICATIONS IN THE CHEMICAL SECTOR</i>	24
ENERGY	24
<i>TABLE 8 RARE EARTH APPLICATIONS IN THE ENERGY SECTOR, 2011</i>	25
LIFE SCIENCES	25
<i>TABLE 9 RARE EARTH APPLICATIONS IN THE LIFE SCIENCES SECTOR</i>	27
SENSORS AND INSTRUMENTATION	27
<i>TABLE 10 RARE EARTH APPLICATIONS IN THE SENSORS AND INSTRUMENTATION SECTOR</i>	28
CONSUMER	28

<b>TOPIC</b>	<b>PAGE NO.</b>
<i>TABLE 11 RARE EARTH APPLICATIONS IN THE CONSUMER SECTOR</i>	29
OTHERS	29
<i>TABLE 12 OTHER RARE EARTH APPLICATIONS, 2011</i>	29
SUMMARY OF DEMAND FOR RARE EARTHS BY INDUSTRY	30
<i>TABLE 13 GLOBAL DEMAND FOR RARE EARTHS BY INDUSTRY (METRIC TONS)</i>	30
CHAPTER 5 RARE EARTH ELEMENT PRODUCTION AND SEPARATIONS	32
ABUNDANCE AND DEPOSIT TYPES OF RARE EARTH ELEMENTS	32
<i>TABLE 14 RARE EARTHS ABUNDANCE IN EARTH'S CRUST</i>	32
FAST FACTS ON RARE EARTH MINERALS	33
<i>TABLE 15 REPRESENTATIVE RARE EARTH CONTENT IN COMMON RARE EARTH MINERALS (RARE EARTH OXIDE %)</i>	33
PROCESSING STEPS	34
<i>TABLE 16 TYPICAL PROCESSING STEPS IN THE RARE EARTH INDUSTRY</i>	34
MINING	35
MINERAL PROCESSING	36
TRENDS IN RECYCLING RARE EARTHS	37
Recycling of Rare Earths for Rechargeable Batteries	37
Nanosized Rare Earths for Soot Reduction	38
INDICATED GLOBAL RARE EARTHS PRODUCTION	38
<i>TABLE 17 RARE EARTHS PRODUCTION BY COUNTRY (METRIC TONS)</i>	40
GAP BETWEEN PRODUCTION AND DEMAND	40
SELECTED AREAS OF RARE EARTHS RESOURCES	40
UNITED STATES	41
<i>TABLE 18 U.S. RARE EARTH RESOURCES</i>	41
CANADA	42
Thor Lake	42
<i>TABLE 19 THOR LAKE, CANADA - NECHALACHO ORE COMPOSITION (PERCENT OF TOTAL RARE EARTH OXIDE (REO))</i>	42
Eldor	43
<i>TABLE 20 ELDOR, CANADA - ASHRAM ZONE ORE COMPOSITION (PERCENT OF TOTAL RARE EARTH OXIDE (REO))</i>	43
Wicheeda	44
Strange Lake	44
<i>TABLE 21 STRANGE LAKE, CANADA - B-ZONE ORE COMPOSITION (PERCENT OF TOTAL RARE EARTH OXIDE (REO))</i>	45
Misery Lake	45
Oka	45
<i>TABLE 22 OKA, CANADA - TYPICAL ORE COMPOSITION (PERCENT OF TOTAL RARE EARTH OXIDE (REO))</i>	46
Hoidas Lake	46
<i>TABLE 23 HOIDAS LAKE, CANADA - TYPICAL RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL RARE EARTH OXIDE (REO))</i>	47
Elliot Lake	47
<i>TABLE 24 ELLIOT LAKE, CANADA - ECO RIDGE RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL RARE EARTH OXIDE)</i>	48
Other Resources	48
Kipawa	48
Eden Lake	49

<b>TOPIC</b>	<b>PAGE NO.</b>
Red Wine	49
Lancer	49
Summary of Rare Earths Resources in Canada	49
<i>TABLE 25 CANADA RARE EARTH RESOURCES</i>	50
BRAZIL	50
Monazite Placers	50
Other Resources	50
Morro dos Seis Lagos	50
Araxá	51
<i>TABLE 26 ARAXA, BRAZIL - TYPICAL RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL REO)</i>	51
Catalão	51
<i>TABLE 27 CATALAO, BRAZIL - TYPICAL RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL REO)</i>	52
REE in Fertilizers	52
Tapira	53
<i>TABLE 28 TAPIRA, BRAZIL - TYPICAL RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL REO)</i>	53
Salitre	54
Pitinga	54
Morro do Ferro	54
<i>TABLE 29 MORRO DO FERRO, BRAZIL - TYPICAL RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL REO)</i>	55
Mato Preto	55
<i>TABLE 30 MATO PRETO, BRAZIL - TYPICAL RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL REO)</i>	55
Summary of Rare Earths Resources in Brazil	56
<i>TABLE 31 BRAZIL RARE EARTH RESOURCES</i>	56
ARGENTINA	56
Rodeo de Los Molles	56
Other Resources	57
INDIA	57
Monazite Placers	57
<i>TABLE 32 INDIA - TYPICAL MONAZITE ORE COMPOSITION (PERCENT OF TOTAL REO)</i>	58
CHINA	58
Bayan Obo	59
<i>TABLE 33 BAYAN OBO, INNER MONGOLIA, CHINA - TYPICAL BASTNASITE ORE COMPOSITION (PERCENT OF TOTAL REO)</i>	59
Weishan	60
Maoniuping	60
<i>TABLE 34 MAONIUPING, SICHUAN, CHINA - TYPICAL ORE COMPOSITION (PERCENT OF TOTAL REO)</i>	60
Ion-adsorption Clays	60
Other Resources	61
<i>TABLE 35 SOUTHERN CHINA - TYPICAL MONAZITE ORE COMPOSITION (PERCENT OF TOTAL REO)</i>	61
Summary of Rare Earths Resources in China	61
<i>TABLE 36 CHINA RARE EARTH RESOURCES, 2011</i>	62
Application Conditions for China Rare Earth Export Quotas (December 5, 2012)	62

<b>TOPIC</b>	<b>PAGE NO.</b>
Other Asian Resources	63
<i>TABLE 37 VIETNAM RARE EARTH RESOURCES</i>	63
SUMMARY OF WORLD RESERVES OF RARE EARTHS	64
<i>TABLE 38 GLOBAL RARE EARTH RESERVES (METRIC TONS-REO EQUIVALENT)</i>	64
CHAPTER 6 FOCUS COMPANIES	67
TOP TEN FOCUS COMPANIES FOR RARE EARTHS	67
BAOTA STEEL RARE EARTH (GROUP) HI-TECH CO., LTD.	67
Business News	68
Products	68
Key Executives	69
Financials	70
CHINA RARE EARTH HOLDINGS LTD. (CRE)	70
Business Profile	71
Products	71
Key Executives	71
Financials	72
SOLVAY GROUP--RHODA S.A.	72
Business Acquisitions	73
Products	73
Key Executives	74
Financials	74
INDIAN RARE EARTHS LTD. (IREL)	74
Business News and Acquisitions	75
Products	75
Development	76
Key Executives	76
Financial	77
MOLYCORP INC.	77
Neo Material Technologies Inc.	77
Business News	77
Acquisitions and Investments	78
Key Executives	79
Financials	80
LYNAS CORPORATION	81
Business News	81
Products	81
Key Executives	82
Financials	83
MITSUI MINING AND SMELTING	83
Business News	83
Products	84
Key Executives	84
Financials	85
IRTYSH RARE EARTHS LTD. (IRESCO)	85
Products	85
Minerals in Kazakhstan	86

<b>TOPIC</b>	<b>PAGE NO.</b>
Key Executives	86
Financials	87
GANSU RARE EARTH GROUP (GSRE)	87
Products	87
Key Executives	87
Financial	88
ARAFURA RESOURCES LTD.	88
Products and Prospects	88
Advancing Technology	89
Key Executives	89
Financials	90
WORTHY OF BEING MENTIONED	90
AVALON RARE METALS INC.	90
BOLERO RESOURCES CORP.	91
CHINA MINMETALS	92
COMMERCE RESOURCES CORPORATION	92
DANDONG JINLONG RARE EARTH	93
FERRO CORPORATION	94
SANTOKU CORPORATION	95
SHIN-ETSU CHEMICAL CO., LTD.	97
SHOWA DENKO	98
OTHER COMPANIES IN THE RARE EARTH BUSINESS IN CHINA	100

### LIST OF TABLES

TABLE HEADING	PAGE NO.
SUMMARY TABLE GLOBAL MARKET FOR RARE EARTHS, THROUGH 2016 (METRIC TONS REO EQUIVALENT)	7
TABLE 1 TYPICAL PROPERTIES OF LANTHANOIDS	12
TABLE 2 TYPICAL RARE EARTH CONTENT IN SELECTED RARE EARTH MINERALS (RARE EARTH OXIDE [REO] %)	13
TABLE 3 PROCESSING STEPS IN THE RARE EARTH INDUSTRY	15
TABLE 4 RARE EARTH ELEMENTS APPLICATIONS IN THE METALLURGICAL AND MECHANICAL SECTOR	19
TABLE 5 RARE EARTH APPLICATIONS IN THE GLASS/CERAMIC SECTOR	21
TABLE 6 RARE EARTH APPLICATIONS IN ELECTRONICS, OPTICS AND OPTOELECTRONICS	22
TABLE 7 RARE EARTH APPLICATIONS IN THE CHEMICAL SECTOR	24
TABLE 8 RARE EARTH APPLICATIONS IN THE ENERGY SECTOR, 2011	25
TABLE 9 RARE EARTH APPLICATIONS IN THE LIFE SCIENCES SECTOR	27
TABLE 10 RARE EARTH APPLICATIONS IN THE SENSORS AND INSTRUMENTATION SECTOR	28
TABLE 11 RARE EARTH APPLICATIONS IN THE CONSUMER SECTOR	29
TABLE 12 OTHER RARE EARTH APPLICATIONS, 2011	29
TABLE 13 GLOBAL DEMAND FOR RARE EARTHS BY INDUSTRY (METRIC TONS)	30
TABLE 14 RARE EARTHS ABUNDANCE IN EARTH'S CRUST	32
TABLE 15 REPRESENTATIVE RARE EARTH CONTENT IN COMMON RARE EARTH MINERALS (RARE EARTH OXIDE %)	33
TABLE 16 TYPICAL PROCESSING STEPS IN THE RARE EARTH INDUSTRY	34
TABLE 17 RARE EARTHS PRODUCTION BY COUNTRY (METRIC TONS)	40
TABLE 18 U.S. RARE EARTH RESOURCES	41
TABLE 19 THOR LAKE, CANADA - NECHALACHO ORE COMPOSITION (PERCENT OF TOTAL RARE EARTH OXIDE (REO))	42
TABLE 20 ELDOR, CANADA - ASHRAM ZONE ORE COMPOSITION (PERCENT OF TOTAL RARE EARTH OXIDE (REO))	43
TABLE 21 STRANGE LAKE, CANADA - B-ZONE ORE COMPOSITION (PERCENT OF TOTAL RARE EARTH OXIDE (REO))	45
TABLE 22 OKA, CANADA - TYPICAL ORE COMPOSITION (PERCENT OF TOTAL RARE EARTH OXIDE (REO))	46
TABLE 23 HOIDAS LAKE, CANADA - TYPICAL RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL RARE EARTH OXIDE (REO))	47
TABLE 24 ELLIOT LAKE, CANADA - ECO RIDGE RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL RARE EARTH OXIDE)	48
TABLE 25 CANADA RARE EARTH RESOURCES	50
TABLE 26 ARAXA, BRAZIL - TYPICAL RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL REO)	51
TABLE 27 CATALAO, BRAZIL - TYPICAL RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL REO)	52
TABLE 28 TAPIRA, BRAZIL - TYPICAL RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL REO)	53
TABLE 29 MORRO DO FERRO, BRAZIL - TYPICAL RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL REO)	55
TABLE 30 MATO PRETO, BRAZIL - TYPICAL RARE EARTH ORE COMPOSITION (PERCENT OF TOTAL REO)	55
TABLE 31 BRAZIL RARE EARTH RESOURCES	56
TABLE 32 INDIA - TYPICAL MONAZITE ORE COMPOSITION (PERCENT OF TOTAL REO)	58
TABLE 33 BAYAN OBO, INNER MONGOLIA, CHINA - TYPICAL BASTNASITE ORE COMPOSITION (PERCENT OF TOTAL REO)	59

<b>TABLE HEADING</b>	<b>PAGE NO.</b>
TABLE 34 MAONIUPING, SICHUAN, CHINA - TYPICAL ORE COMPOSITION (PERCENT OF TOTAL REO)	60
TABLE 35 SOUTHERN CHINA - TYPICAL MONAZITE ORE COMPOSITION (PERCENT OF TOTAL REO)	61
TABLE 36 CHINA RARE EARTH RESOURCES, 2011	62
TABLE 37 VIETNAM RARE EARTH RESOURCES	63
TABLE 38 GLOBAL RARE EARTH RESERVES (METRIC TONS-REO EQUIVALENT)	64



**LIST OF FIGURES**

<b>FIGURE TITLE</b>	<b>PAGE NO.</b>
SUMMARY FIGURE GLOBAL MARKET FOR RARE EARTHS, 2009-2016 (METRIC TONS — REO EQUIVALENT)	7
FIGURE 1 RARE EARTHS IN THE PERIODIC CHART	10