

*Verwendung von Naturgraphit in  
Lithium-Ionen-Akkus*

*Auslöser eines Explorationsbooms*

**Christoph Frey** ProGraphite GmbH

AKK - Frühjahrstagung 2016



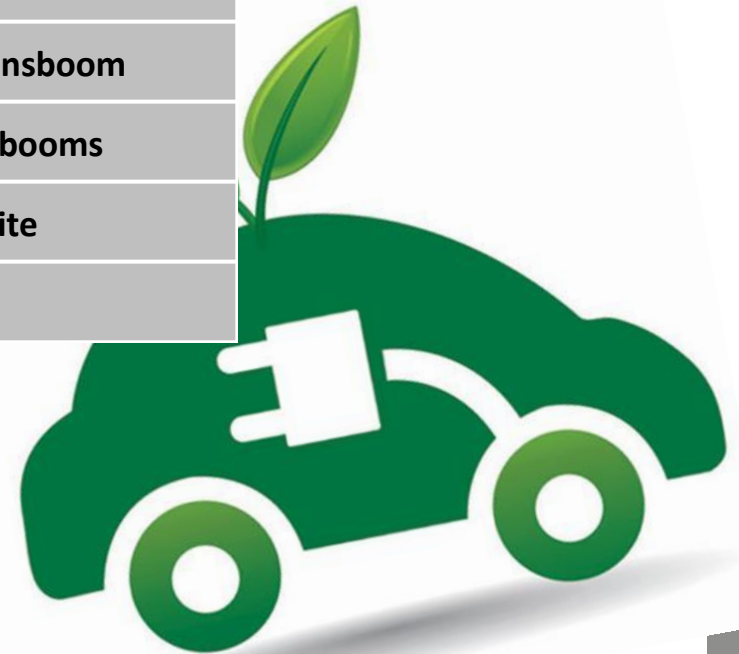
**ARBEITSKREIS KOHLENSTOFF**  
DER DEUTSCHEN KERAMISCHEN GESELLSCHAFT E.V.



## *Verwendung von Naturgraphit in Lithium-Ionen-Akkus*

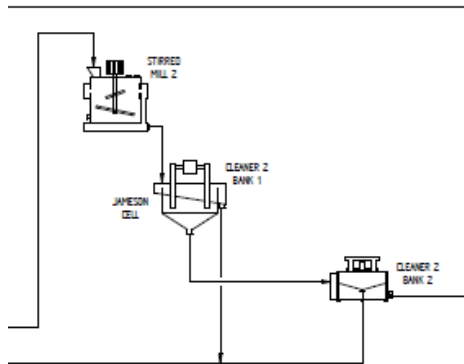
### *Auslöser eines Explorationsbooms*

Gliederung	
1.	Vorstellung ProGraphite GmbH
2.	Weltmarkt Naturgraphit
3.	Ursachen für den Explorationsboom
4.	Ergebnisse des Explorationsbooms
5.	Fallbeispiel Northern Graphite
6.	Zusammenfassung



## Consulting

- Kompetente Betreuung von Natur-Graphitprojekten ; von der Lagerstättenbewertung bis zum Produktmarketing
- Neutrale Evaluierung von Projekten
- Planungsinput für Produktionsanlagen
- Laufendes Mandat für Kibaran Res.



## Labor Services

- Durchführung neutraler Laboranalysen nach Industriestandard im eigenen Labor
- Kompetente Interpretation von Analyseergebnissen
- Durchführung und Überwachung von Spezialtests in externen Laboren / Pilotanlagen etc.



## Handel

- Handel mit Graphit und Carbonprodukten
- Fokus auf Spezialitäten wie sphärischer Graphit, Blähgraphit usw.
- Entwicklung bedarfsgerechter Sorten
- Sales Representative für die Graphexel Ltd.



## The Epanko Graphite Project : The New Source for Europe for Flake Graphite

ProGraphite GmbH ist der  
Graphit-Consultant für  
Kibaran Resources

ASX: KNL

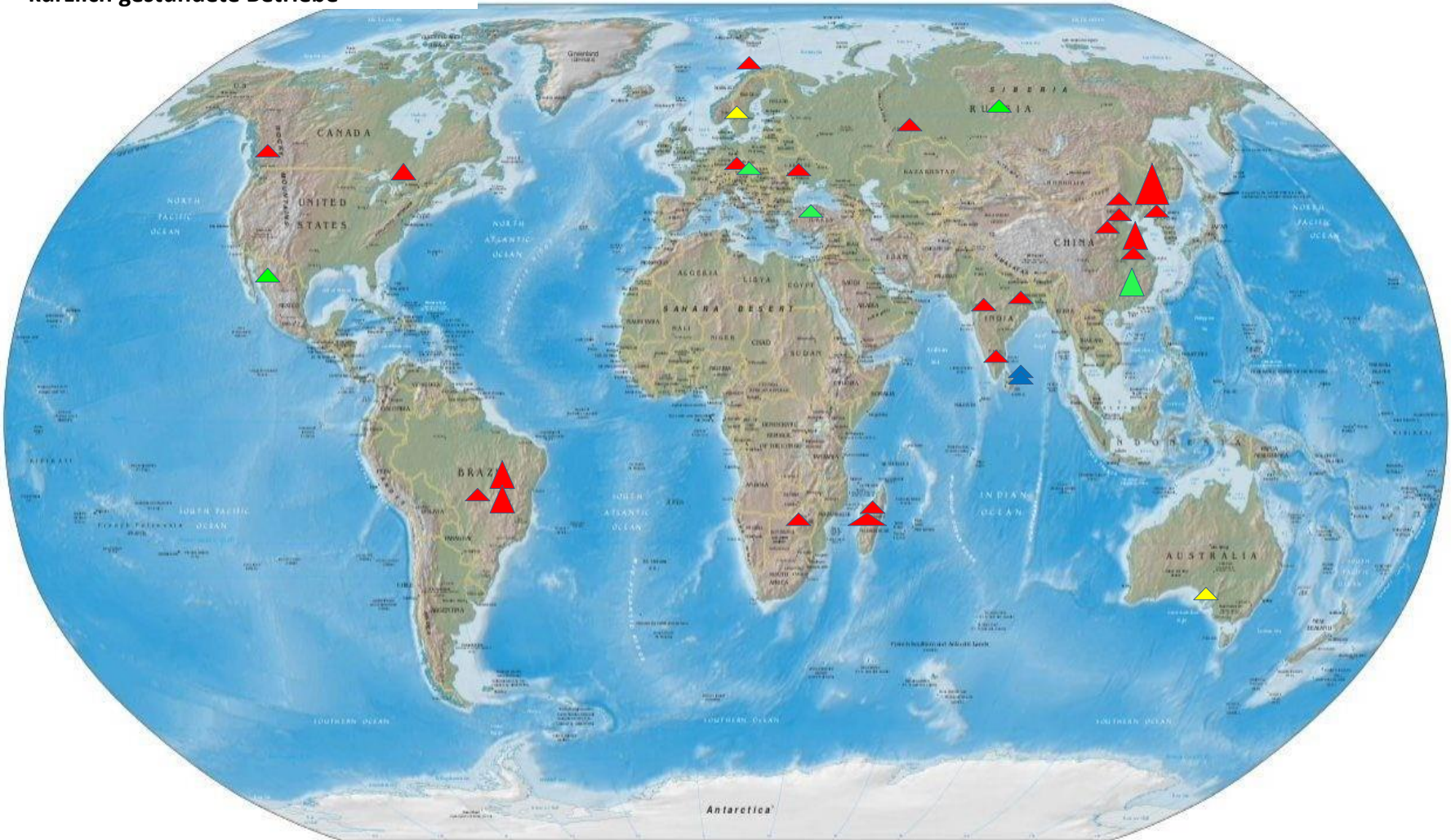
### ■ World-class graphite assets in Tanzania

- Bankable Feasibility Study completed
- Off-take agreement signed with ThyssenKrupp for 20,000tpa
- Off-take agreement signed with major European graphite trader for 10,000tpa
- Annual production of 40,000tpa
- German KfW-Bank completing due diligence on US\$40m project debt funding with in-principle German Government Loan Guarantee (UFG)
- European centred Blue Chip Partners for Offtake and Financing

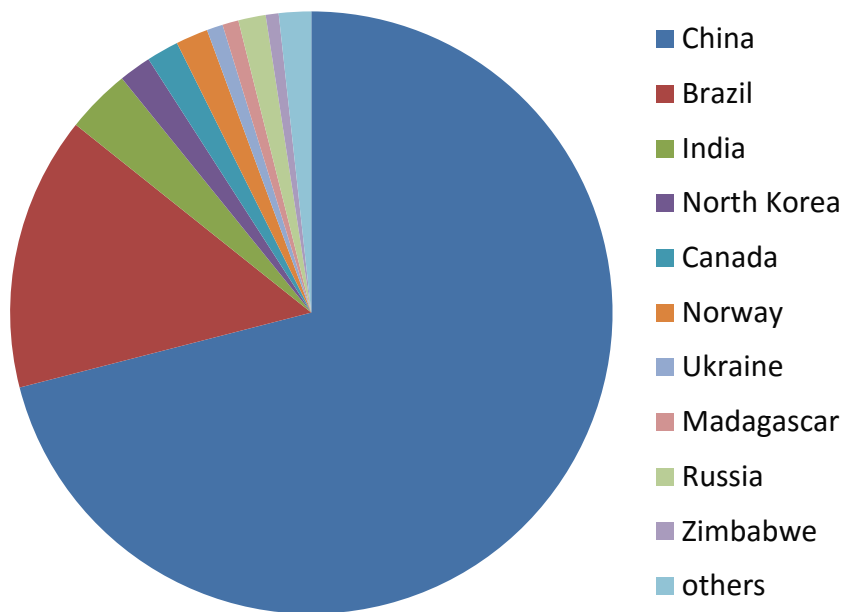


Supply to High Growth  
Lithium-Ion Battery Market

- ▲ Flockengraphit
- ▲ amorpher Graphit
- ▲ Vein-Graphit
- ▲ kürzlich gestundete Betriebe



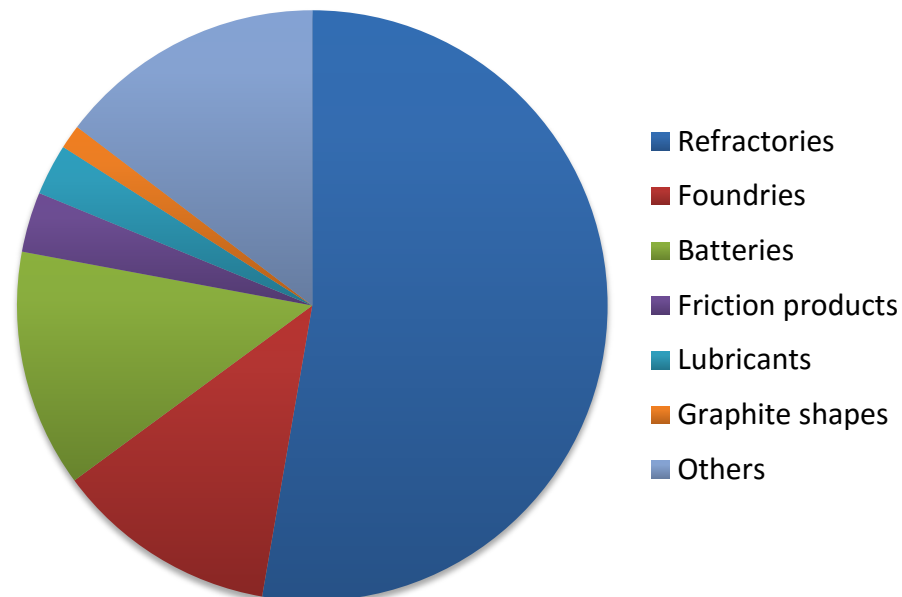
## World Production of Natural Flake Graphite 2014



World Production of Natural Flake Graphite 2014 (ktons)

China	Brazil	India	Canada	Others	Total
410	85	25	10	75	605

## Consumption of Natural Flake Graphite 2014



Estimated consumption of flake graphite by region in 2014 (ktons)

Asia	Europe	N. America	S. America	Others	Total
389	80	54	60	22	605

*Demand Driver for Flake Graphite are Li-Ion Batteries with CAGR >>10%  
In 2025 > 200 kton Flake Graphite Consumption only for Batteries*

- a) Klassifizierung von Natur-Graphit als kritischer Rohstoff
- b) Preispeak in 2010-2012
- c) Umwandlungsmöglichkeit von Naturgraphit in Graphene
- d) Wachstumsprognosen Lithium-Ionen-Batterien v.a. für elektrische Fahrzeuge / Tesla Ankündigung einer Giga-LIB-Fabrik in USA

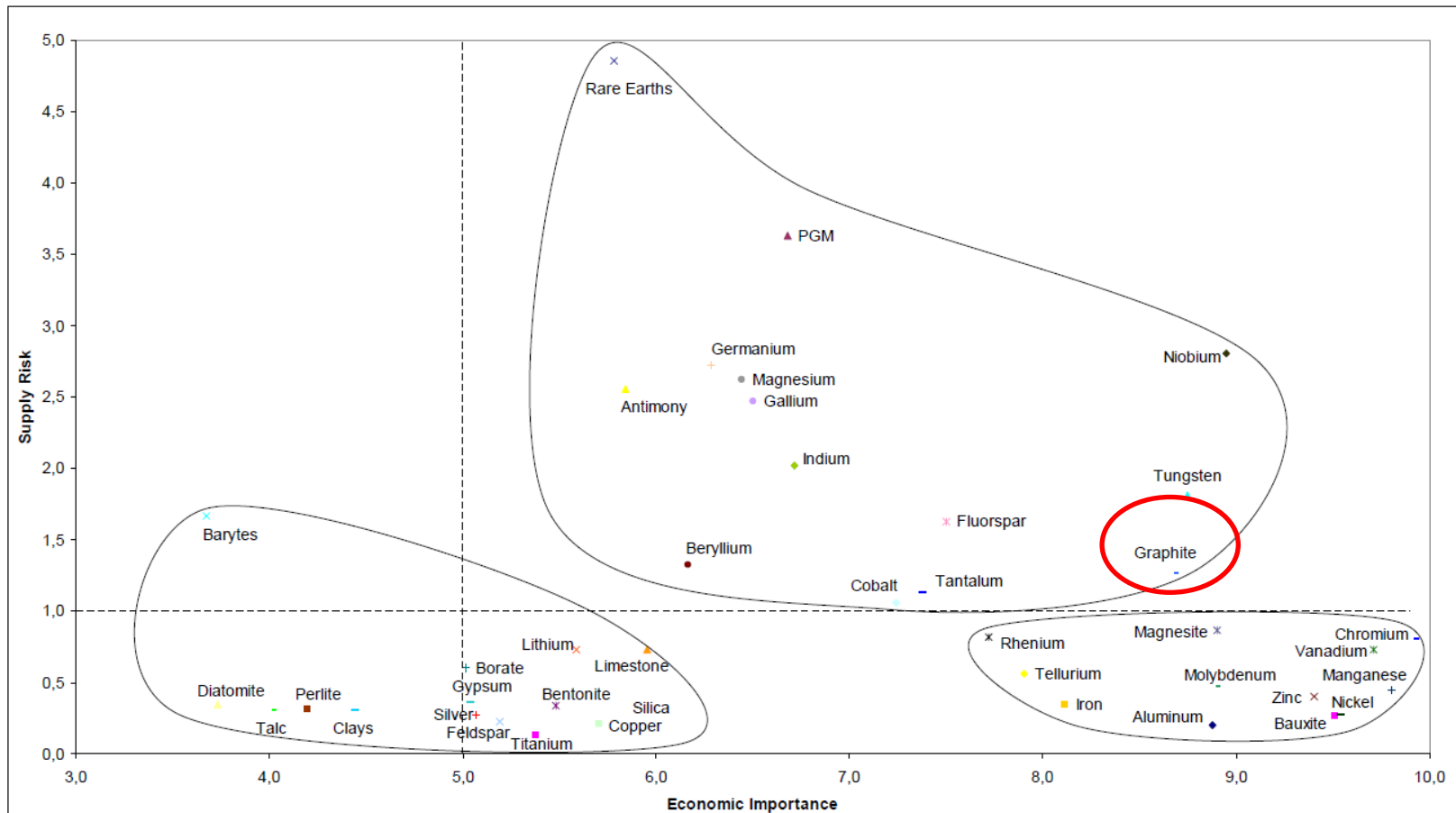
- ⇒ Ideales Umfeld für börsennotierte Junior Explorers and Miners
- ⇒ schlagartige Zunahme von börsennotierten Graphitprojekten ab 2010
- ⇒ Notierungen vor allem in Australien (ASX) und Kanada (TSVX)



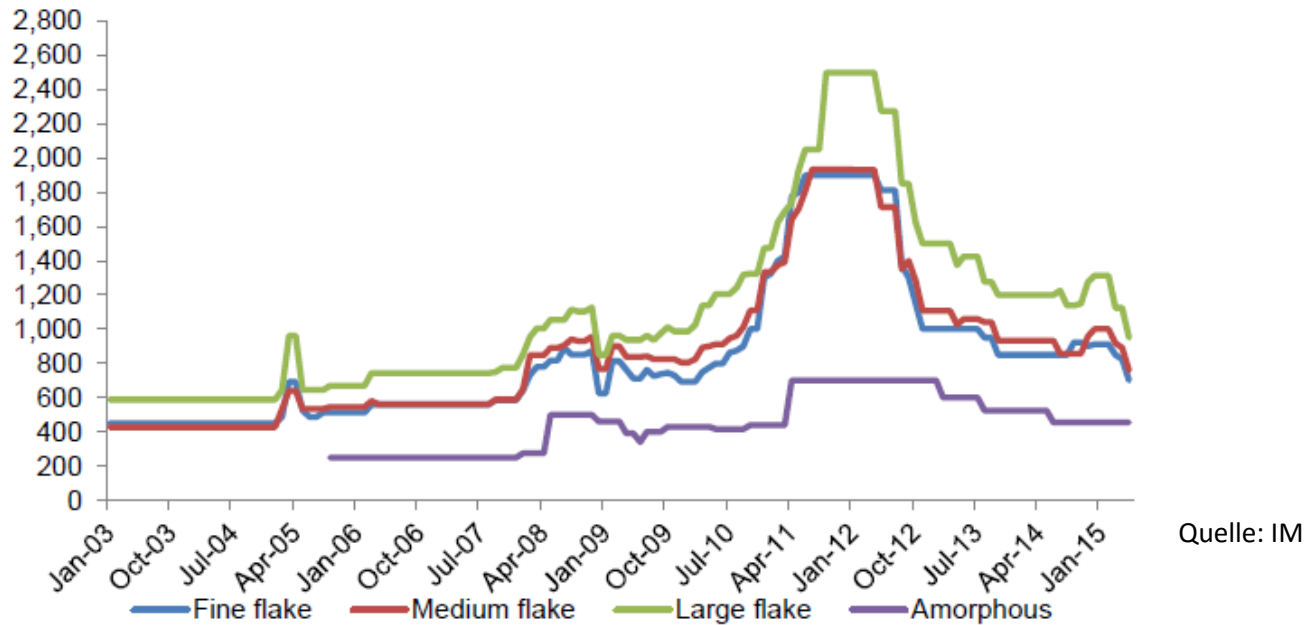
IP/10/752 Brüssel, 17. Juni 2010

## Bericht zufolge 14 wichtige mineralische Rohstoffe knapp

Rohstoffe sind ein wesentlicher Bestandteil sowohl von High-Tech-Produkten als auch von Produkten des täglichen Gebrauchs, darunter etwa Mobiltelefone, Dünnschichtphotovoltaikmodule, **Lithium-Ionen-Batterien**, Glasfaserkabel und synthetische Treibstoffe. Nach dem heute veröffentlichten Bericht einer Expertengruppe unter dem Vorsitz der Europäischen Kommission treten bei der Versorgung mit diesen Rohstoffen jedoch zunehmend Engpässe auf...







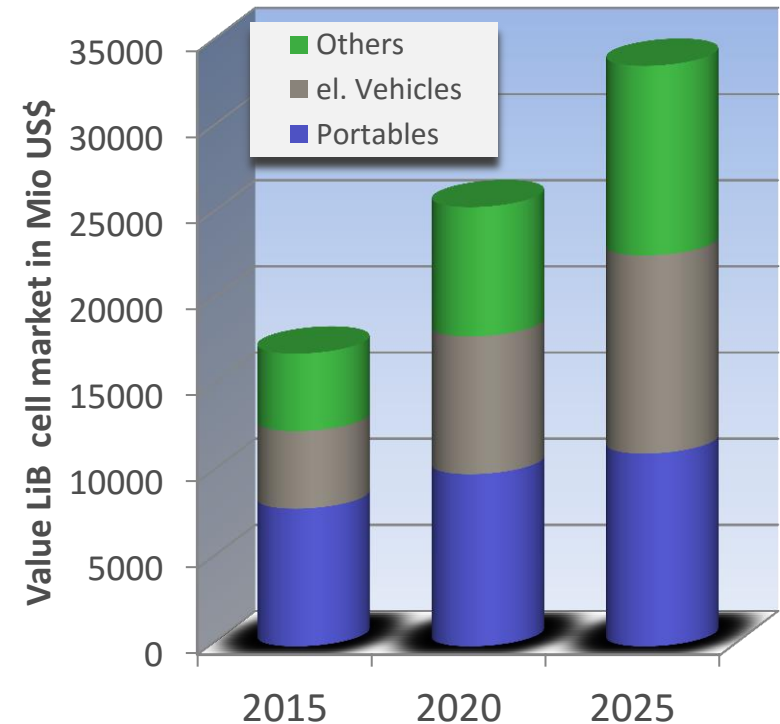
- relativ stabile Preise bis 2007
- Preisanstieg in 2007 und wegen höherer Kosten für Energie, Logistik sowie der Einführung einer Export Duty sowie Änderung der VAT auf 17%
- In 2008 weiterer Preisanstieg durch Verknappung insbesondere bei größeren Flocken (wg. Inner Mongolia)
- 2009 globale Finanz- und Wirtschaftskrise: fallende Preise und Überangebot
- **2010: Erholung der Weltwirtschaft, erhöhter Bedarf trifft auf reduzierte Produktion; Preissteigerungen**
- **2011: Massive Zollaktion bei verschiedenen Graphitbetrieben wegen unzulässiger Exportpraxis; dadurch Unsicherheit bei Exporteuren, reduzierte Produktion und Export führt zu weitere Preissteigerungen**
- 2012: Preise auf hohem Niveau bis Mitte 2012; seither schrittweiser Preisverfall
- 2015: Preise auf niedrigstem Niveau seit 2009; reduzierte Abnahme durch Stahlindustrie; massive Überkapazitäten in China

⇒ **Preiserhöhungen von 2010 bis 2012 ideal für Junior Mining Companies ; Hoffnung auf Langfristtrend**



## Graphite is the dominant Anode Material for LiB

- Current market share of graphite above 90%
- Thereof: approx. 55% natural, 45% synthetic
- Often mixture of different types of graphite/carbon in one cell
- Advantages Natural Graphite vs. Synth. Graphite: mainly lower price
- But: Synth. Graphite more customizable and stable
- **Almost 100% supply of natural spherical graphite from China**
- Value share of the anode material 5 and 10% of the total cost of the LiB cell
- **Value for anode material will increase from currently \$1 billion to \$ 2,6 billion in 2025 (CAGR 10%)**

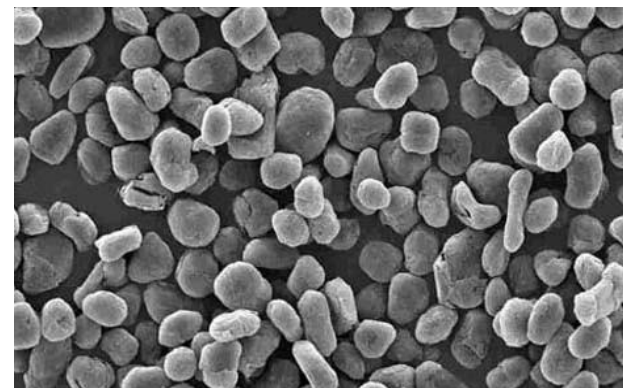
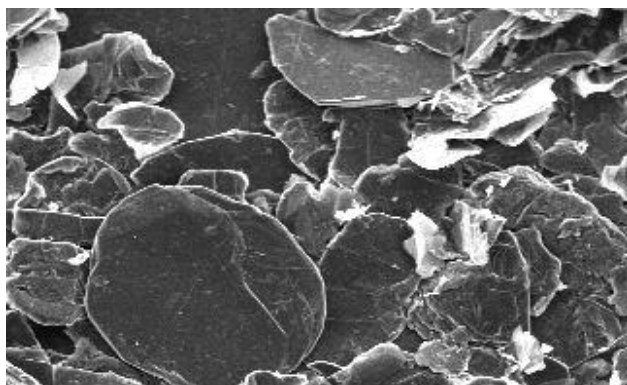
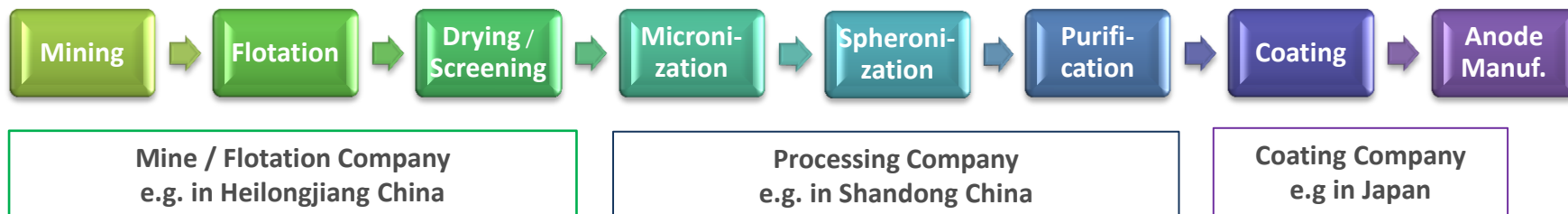


Portables: Laptops, Tablets, Cell Phone, Camcorder, etc.

el. Vehicles: HEV, PHEV and EV

Others: E-Bikes, Powertools, Telecom, ESS, Medical Devices etc.

## Process Flow for Production of Spherical Natural Graphite from the Mine to the Anode Producer



**Flake Graphite is converted from a raw material into sophisticated high tech product!**  
(That's a quite challenging approach for any Junior Mining Company!)

### Additional Demand of Flake for LIB only

Items		2015	2020	2025
Anode material needed for LiB	(ktpa)	70	160	270
(Spherical) graphite needed	(ktpa)	67	146	238
Spherical natural graphite needed	(ktpa)	37	73	119
Natural graphite needed as feed	(ktpa)	73	143	224
Additional demand of nat. graphite vs. 2015	(ktpa)		70	151

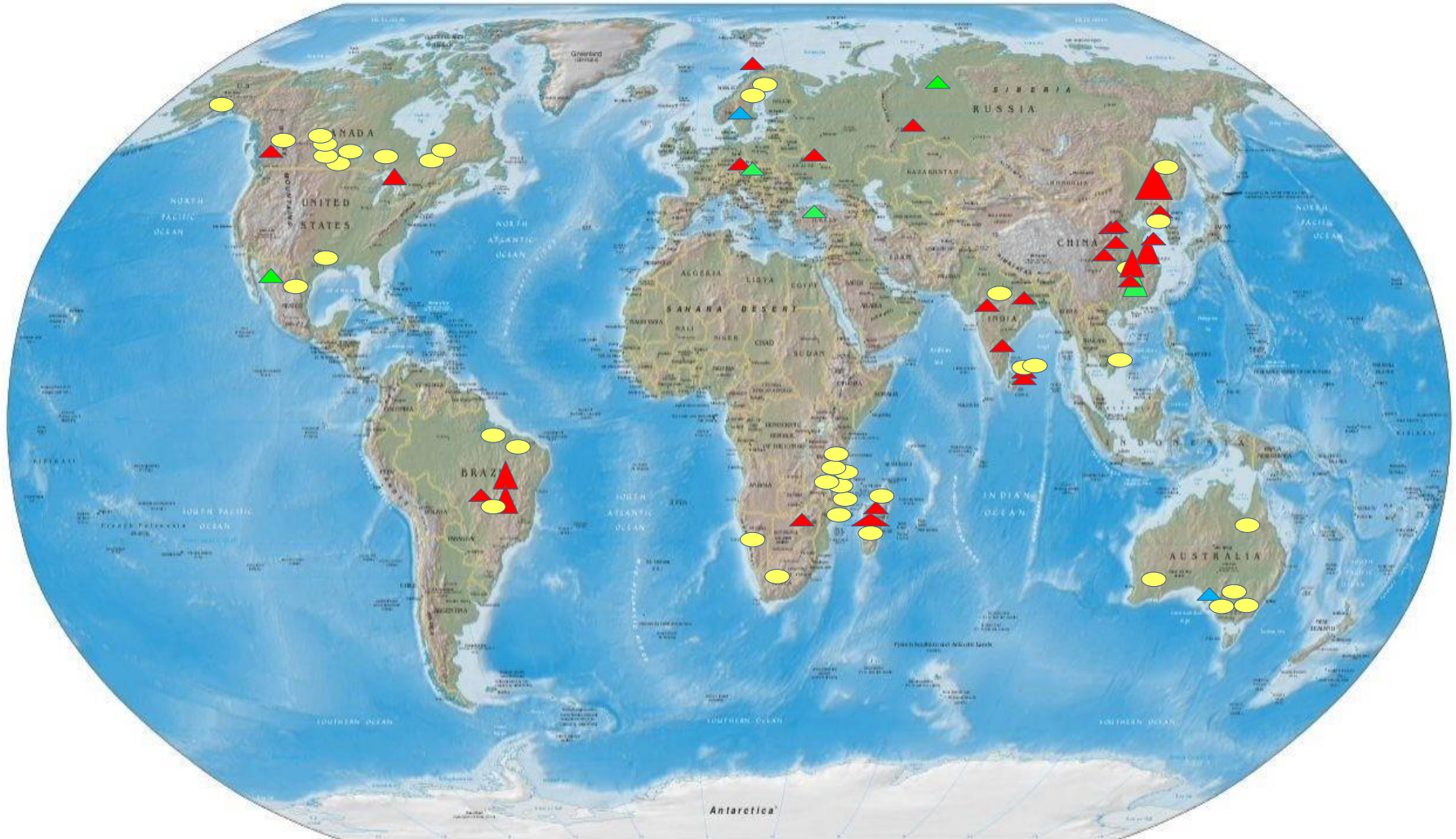
# Ergebnisse des Explorationsbooms

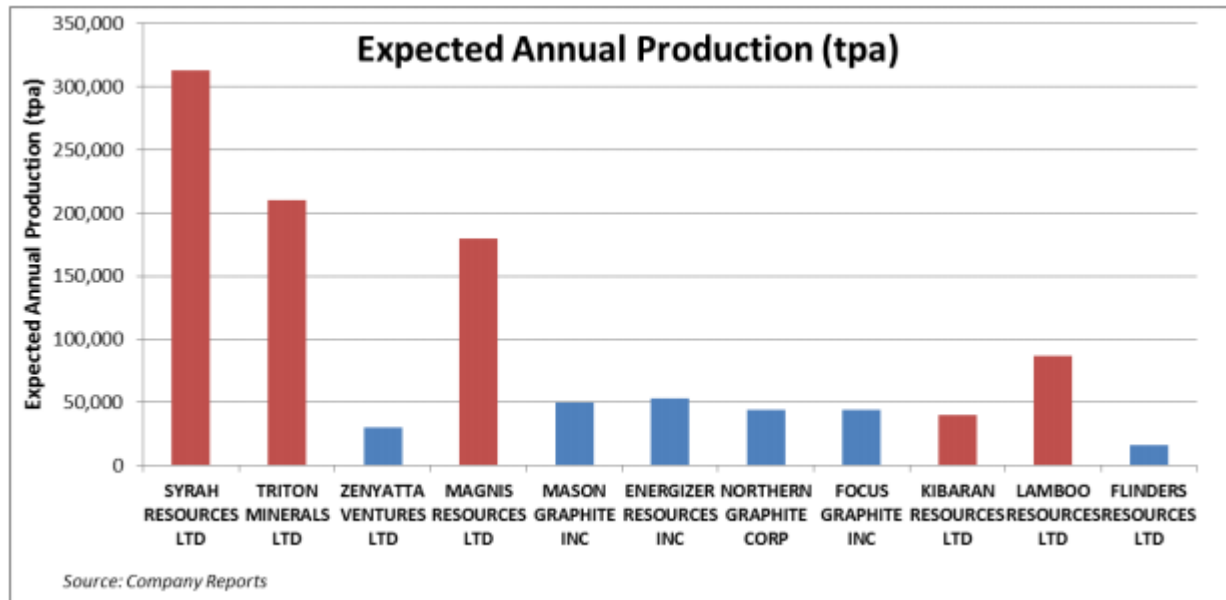
InvestorIntel: Graphite & Graphene	Ticker Symbol	Currency	Share price market close September 12, 2014*	Share price market close September 19, 2014*	% Change in share price Sep 12-19, 2014	Market Capitalisation as on Sep 22, 2014
Syrah Resources Ltd.	ASX: SYR	AUD	\$4.7400	\$4.6500	-1.90%	\$749,871,824
Valence Industries Ltd.	ASX: VXL	AUD	\$0.8000	\$0.7300	-8.75%	\$116,034,092
Zenyatta Ventures Ltd.	TSXV: ZEN	CAD	\$2.0600	\$2.0200	-1.94%	\$108,161,182
Zenyatta Ventures Ltd.	OTCQX: ZENYF	USD	\$1.7380	\$1.8500	6.44%	\$100,653,847
Triton Minerals Limited	ASX: TON	AUD	\$0.3500	\$0.3250	-7.14%	\$84,049,555
Lambo Resources Ltd.	ASX: LMB	AUD	\$0.6250	\$0.6050	-3.20%	\$79,982,089
Mason Graphite Inc.	TSXV: LLG	CAD	\$0.7300	\$0.7000	-4.11%	\$58,334,503
Mason Graphite Inc.	OTCQX: MGPHF	USD	\$0.6489	\$0.6418	-1.09%	\$53,393,228
Talga Resources Ltd.	ASX: TLG	AUD	\$0.4700	\$0.4600	-2.13%	\$56,070,000
Focus Graphite Inc.	TSXV: FMS	CAD	\$0.5400	\$0.5200	-3.70%	\$54,611,738
Focus Graphite Inc.	OTCQX: FCSMF	USD	\$0.4869	\$0.4710	-3.27%	\$48,186,827
Energizer Resources Inc.	TSXV: EGZ	CAD	\$0.2450	\$0.1850	-24.49%	\$51,039,245
Energizer Resources Inc.	OTCQX: ENZR	USD	\$0.2199	\$0.1640	-25.42%	\$45,666,693
Northern Graphite Corp.	TSXV: NGC	CAD	\$1.0800	\$0.9100	-15.74%	\$45,738,591
Northern Graphite Corp.	OTCBB: NGPHF	USD	\$0.9680	\$0.8340	-13.84%	\$41,804,088
Flinders Resources Ltd.	TSXV: FDR	CAD	\$0.8300	\$0.7200	-13.25%	\$32,774,511
Kibaran Resources Ltd.	ASX: KNL	AUD	\$0.3250	\$0.3000	-7.69%	\$25,382,500
Strategic Energy Resources Ltd.	ASX: SER	AUD	\$0.0810	\$0.0760	-6.17%	\$24,403,575
Sovereign Metals Ltd.	ASX: SVM	AUD	\$0.2700	\$0.2500	-7.41%	\$22,641,679
Alabama Graphite Corp.	TSXV: ALP	CAD	\$0.2300	\$0.2550	10.87%	\$21,198,144
Alabama Graphite Corp.	OTCQB: ABGPF	USD	\$0.2300	\$0.2399	4.30%	\$19,831,959
Graphite One Resources Inc.	TSXV: GPH	CAD	\$0.1650	\$0.1600	-3.03%	\$18,002,581
Graphite One Resources Inc.	OTCQX: GPHOF	USD	\$0.1441	\$0.1450	0.62%	\$17,423,931
Archer Exploration Ltd.	ASX: AXE	AUD	\$0.2050	\$0.1950	-4.88%	\$16,202,314
Lomiko Metals Inc.	TSXV: LMR	CAD	\$0.0800	\$0.0700	-12.50%	\$10,241,488
Lomiko Metals Inc.	OTCQX: LMRMF	USD	\$0.0700	\$0.0641	-8.43%	\$9,695,275
Elcora Resources Corp.	TSXV: ERA	CAD	\$0.2700	\$0.2300	-14.81%	\$10,195,408
Great Lakes Graphite Inc.	TSXV: GLK	CAD	\$0.0900	\$0.1100	22.22%	\$7,291,778
(*) Stock price were compiled from the following sources: TMX.com, OTCQX.com, Bloomberg.com, Google Finance & YahooFinance.com. ProEdge Media Corp. assumes no liability for misprints.				<b>Average % change</b>	<b>-5.37%</b>	<b>\$1,928,882,642</b>

- > 200 Projekte, vor allem in Kanada und Süd-Ost-Afrika
- meist kanadische und australische börsennotierte Firmen; einige private (z.B. aus Indien)
- Kanadische Firmen Trendsetter
- > 2 Mrd € Aktienkapital in Naturgraphit-Projekten investiert
- theor. > 1.500.000 to zusätzliche Kapazität VS. tatsächlicher zusätzlicher Bedarf?

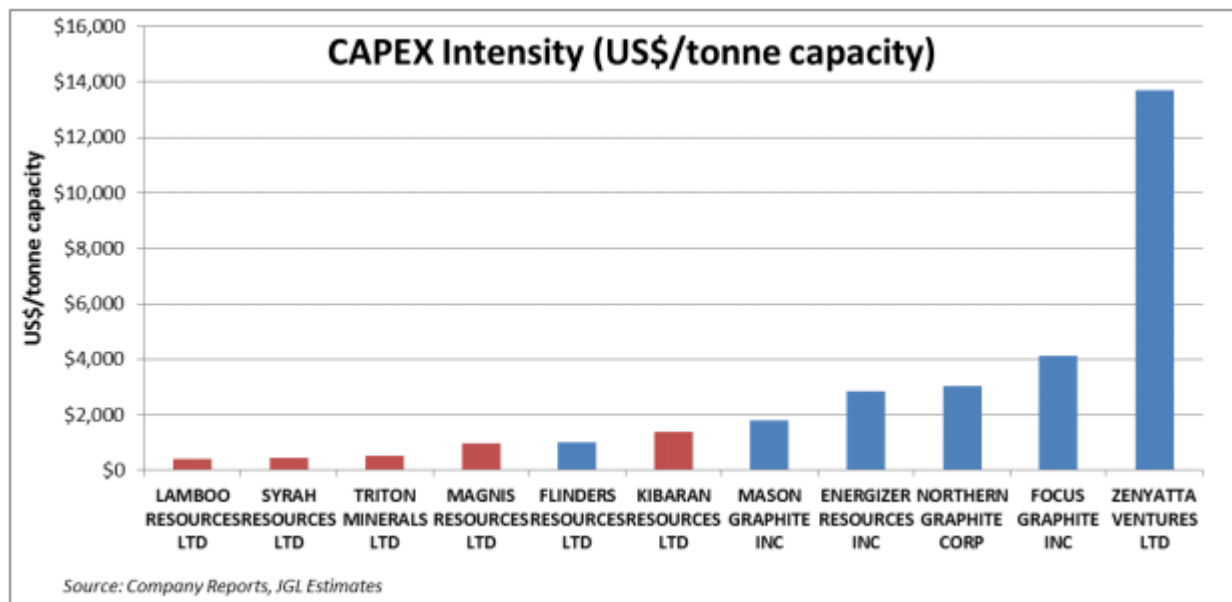
Quelle:  
InvestorIntel  
(sponsored by Alabama Graphite Corp)

● Naturgraphit Explorationsprojekt



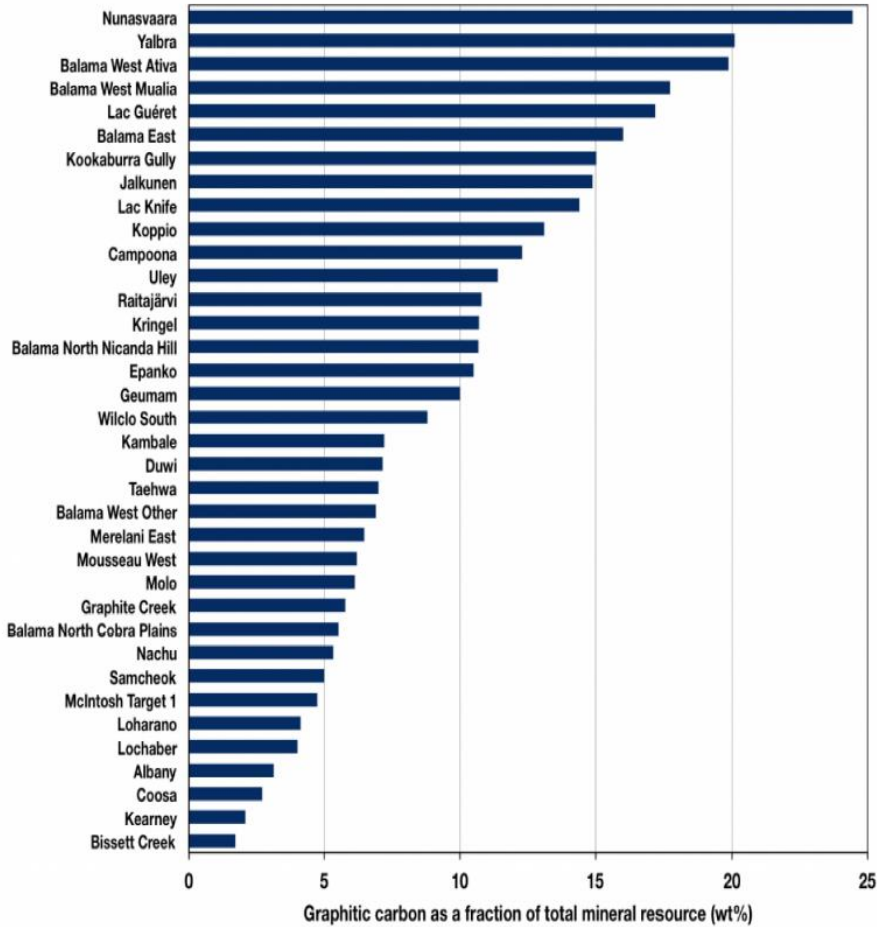


rot = Australien  
blau = Kanada

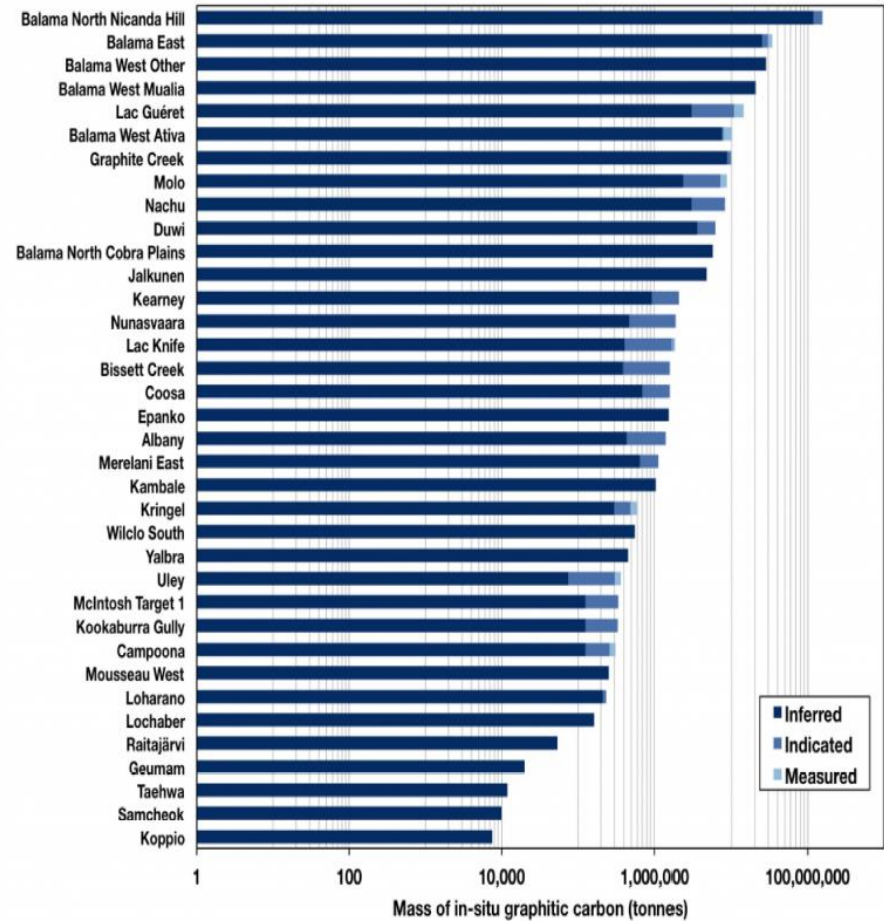


Quelle: THE DISRUPTIVE DISCOVERIES JOURNAL Juni 2015

### Average Grade of In-situ Graphite



### Quantity of In-situ Graphite



source: Technology Metals Research

**Oktober 2009**

“...to form a new company to be called Northern Graphite Corporation“



...

### “About Graphite

Graphite prices have increased substantially as a result of growing demand in traditional steel and automotive markets...Demand for high-quality graphite is expected to accelerate due to emerging applications such as **lithium ion batteries**, fuel cells....

China produces more than 70% of the world’s graphite ... but has implemented export restrictions and quotas. Concerns over China’s supply and declining quality of graphite have also had a positive impact on graphite prices.

Gregory Bowes, CEO of IMC stated that “we are the first graphite company to attempt to go public in many years and this involves a substantial market education process...”



## 2009

Corporate Update – October 28, 2009

## 2010

Northern Graphite Completes \$2.1M Financing – March 8, 2010

Northern Starts Environmental and Permitting Process – April 1, 2010

Northern Initiates Pre Feasibility Study – April 19, 2010

Bissett Creek Drill Program Starts – July 7, 2010

## 2011

Northern Reports Positive Drill Results From Bissett Creek Project– May 17, 2011

Northern Graphite Announces Bankable Feasibility Study – June 21, 2011

Northern Graphite Announces Successful Test Production of Graphene – July 21, 2011

Northern Graphite Reports Metallurgical Test Results – September 23, 2011

## 2012

Northern Graphite Reports Positive Pilot Plant Test Results – January 11, 2012

N.G. successfully produces and tests spherical graphite for LiB – April 2, 2012

N.G. Signs Two Agreements for Further Spherical Graphite Testing – May 14, 2012

BFS available at [sedar.com](http://sedar.com) and on website – August 27, 2012

Northern Graphite submits major permit required for construction – October 31, 2012

## 2013

Northern Announces Equipment Financing Deal with Caterpillar – January 8, 2013

N.G. Awards Detailed Engineering and Design Contract– January 18, 2013

N.G. Receives Major Permit Approval and Mining Lease – August 26, 2013

N.G. Announces Updated Feasibility Study Economics -September 23, 2013

N.G. Develops Proprietary Purification Technology -September 30, 2013

## 2014

N.G. Develops and Successfully Tests Spherical Graphite Coating – March 19, 2014

Northern Graphite Looking at Doubling Bissett Creek Production Rate – May 7, 2014

Northern Graphite Confirms High Spherical Graphite Yield – August 12, 2014

Northern Graphite Creates Open Source Battery Research and Testing Facility – November 10, 2014

## 2015

N.G. Qualifies Bissett Creek Concentrates for Major Graphite Markets – March 2, 2015

N.G. Provides First Commercial Spherical Graphite Samples – May 19, 2015

## 2016

Northern Graphite Advances Purification Technology – February 8, 2016

Northern Graphite Advances Coating Technology – March 8, 2016

Graphite Companies Join Forces for Spherical Graphite Development – March 2016

## Graphite Companies Join Forces for Spherical Graphite Development – March 2016

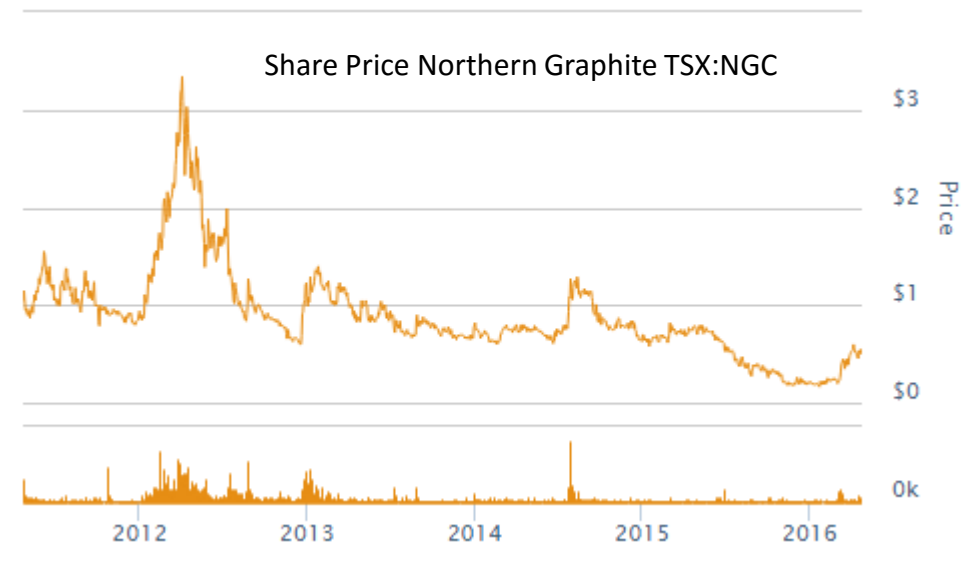
Elcora Advanced Materials Corp, Northern Graphite Corporation, Nouveau Monde Mining Enterprises Inc., Metals of Africa Limited, Coulometrics LLC and a private industry partner are pleased to announce that they are jointly acquiring a micronizing and spheronizing mill to produce spherical graphite (“SPG”), a critical step in the production of anode material used in lithium ion batteries (“LIBs”). The mill will be added to Coulometrics’ battery production and test facility.

### Currently:

- Usage of large flakes
- Thermal purification
- CVD coating

=> **expensive processing –  
neither price nor quality competitive**

News flow focussed on LIB since  
TESLA Gigafactory announcement  
in 2013



## Zusammenfassung :

- Hoher Bedarf an Flockengraphit für LIB war eine Hauptursache für den Explorations-Boom
- Nachdem andere Gründe weggefallen (hoher Preis) oder in den Hintergrund getreten sind (Versorgungssicherheit), ist Verwendung in Lithium-Ionen-Batterien der Hauptgrund für anhaltendes Interesse an Graphitprojekten
- Nur mit traditionellen Anwendungen (Feuerfest, Schmierstoffe etc.) kann kein Geld an Aktienmärkten gesammelt werden.
- Teilweise abenteuerliche Stories wie Verwendung als Nukleargraphit oder Graphen-Precursor
- Etablierte Naturgraphit-Betriebe wie Graphit Kropfmühl oder NdG (Brasilien) interessanterweise sehr zurückhaltend bei Naturgraphit für LiB...
  
- Zwei Brownfield Projekte wurden in den letzten Jahren wieder in Betrieb genommen (Woxna in Schweden und Uley in Australien), beide mittlerweile gestundet
- Derzeit Finanzierung von lediglich zwei weiteren Projekten gesichert: quasi David und Goliath der Branche, beide im Norden von Mozambique
  - Ancuabe in Mozambique von Graphit Kropfmühl (ca. 7.000 to/a)
  - sowie Balama in Mozambique von Syrah Resources (geplant 350.000 to/a)  
 Börsenwert Syrah: 720 Mio € !!!
- Marktbereinigung der Projekte vorhersehbar, nur wenige Betriebe werden nachhaltig erfolgreich errichtet und in Betrieb sein – Kibaran Resources ist in vielversprechender Position

**Vielen Dank für Ihre Aufmerksamkeit !**

Pro**Graphite** 

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