SAVANNAH

# Successful Glass & Ceramics Test Work Programme Completed on Co-Product Feldspar and Quartz at Mina do Barroso Lithium Project

13th AUGUST 2019

**Highlights:**

- Test work programme demonstrates that feldspar and quartz from Mina do Barroso's spodumene concentrate tails are suitable for use in a range of glass and ceramic applications
- Test work has confirmed that the bulk tail from the spodumene concentrator is also a saleable product requiring no further processing
- Successful test work validated Mina do Barroso feldspar for both ceramic bodies and glazes, and float and container glass, in addition to validating Mina do Barroso quartz for lead crystal and container glass
- Marketing studies concluded that prices for Mina do Barroso co-products could be significantly higher than reported in the 2018 Scoping Study, with feldspar at US$65-100/t vs. US$39/t, quartz at US$60-100/t vs. US$33/t and a bulk tail at US$40-45/t
- Glass and ceramics are two of the biggest global markets for feldspar and quartz
    - Mina do Barroso is geographically well positioned to supply markets in Portugal, Spain and other European countries
- Discussions underway with potential offtake and JV partners to advance the co-product opportunity
- Sale of products derived from the lithium concentrator tails would generate additional revenue and reduce the costs and the footprint associated with waste storage on site
- The test work programme was designed and managed by experienced industry professionals, First Test Minerals

Savannah Resources plc (AIM: SAV, FWB: SAV and SWB: SAV) ('Savannah' or the 'Company'), the AIM quoted resource development company, which is focused on becoming Europe's most significant producer of lithium spodumene concentrates from its wholly owned Mina do Barroso Project in Portugal ('Mina do Barroso' or 'the Project'), is pleased to announce that its ongoing metallurgical test work programme has successfully produced saleable co-products from the ongoing ceramics test work programme.

Mina do Barroso is currently targeting an average annual production rate of 175,000 tonnes of battery grade spodumene lithium concentrate in addition to targeting the production of feldspar and quartz co-products for the regional glass and ceramics industries. Co-product sales will add valuable additional revenues to the Project as well as reducing the environmental footprint and costs associated with waste handling and storage, adding substantially to Mina do Barroso's commercial appeal.

**Savannah's CEO, David Archer said:** *"Glass and ceramics are huge global industries, with Europe representing 25% of global production of ceramics. Feldspar and quartz products have been produced in this region of Portugal for decades and are well regarded by glass and ceramic manufacturers in the domestic market and in Spain. The completed test work has validated Mina do Barroso's feldspar and quartz for these applications. Producing saleable products from the waste stream of the spodumene concentrator will help to reduce the operating costs and the footprint associated with handling and storing waste material on the Project site.*

*"Very significantly, the test work has also confirmed that there is potential for the sale of a combined feldspar and quartz bulk tail (Mina do Barroso Fine Grade Feldspar) from Mina do Barroso requiring no further processing. Production of this bulk material would also potentially eliminate approximately US$15m from the estimated processing plant capex that would be required to produce separate quartz and feldspar co-products. At the same time the estimated unit sale price of the bulk product is likely to exceed the prices for separate feldspar and quartz products assumed in the June 2018 Scoping Study. Test marketing to potential customers is now underway."*

**MARKETS - CERAMICS**

The global ceramics market is worth around US$100 billion and is expected to grow at a compound annual growth rate of approximately 6% during the period 2019-2029 (source: Fact.MR). The EU ceramics industry represents an annual production value of ~€30 billion, accounting for one third of global production value and supports over 200,000 direct jobs throughout the EU (source: Cerame-Unie). The major producing countries in the EU are Italy, Germany, Spain, France, UK, Portugal and Austria, with Spain and Portugal producing an estimated 570 million square metres of ceramic tiles per annum (source: First Test Minerals).

**MARKETS - GLASS**

The glass industry is the largest consumer of feldspar globally (source: Mordor Intelligence). Europe is the biggest market for feldspar (source: Global Industry Analysts), due to its high production and consumption of glass. Feldspars are used in the production of both flat and container glass. Container glass is the largest sector in Europe, accounting for 21.8Mt, or over 60% of the 35.4Mt of total glass production with approximately 160 manufacturing plants distributed all over Europe (Source: Glass Alliance Europe). Flat glass is the second largest sector (10.6Mt, or 29% of total European production) with the biggest markets in building (windows and facades) and automotive industries (windscreens, front and rear side windows, lights and sunroofs). Flat glass is also used in solar-energy applications (photovoltaic and solar thermal panels) as well as in domestic furniture, mirrors and greenhouses. Flat glass is manufactured in Europe by seven companies operating some 60 float glass plants, each having a typical capacity of ~650 tonnes of melted glass per day (source: Glass for Europe).

**WORK PROGRAMME SUMMARY**

**Sample Selection and Refining**

Samples of quartz and feldspar co-product from Savannah's Mina do Barroso Lithium Project in northern Portugal have been successfully evaluated in a range of industrial glass and ceramics applications. In each case, comparisons were made with current commercial grades in regular use throughout Western Europe.

A carefully selected blend of core drill samples, fully representative of the spodumene pegmatite, were ground to optimum particle size and processed by conventional flotation techniques by Nagrom in Kelmscott, Western Australia to produce three commercial co-products:

- Quartz / Feldspar Tailings (bulk tail to be produced from the spodumene concentrator)
- Refined Feldspar (separated product from the bulk tail)
- Refined Quartz (separated product from the bulk tail)

**Sample Analysis**

Each sample was analysed for mineralogy, chemistry, particle sizing and other properties so that comparisons against other leading grades on the market could be made and detailed technical data sheets drawn up.

The three grades were given the following commercial names:

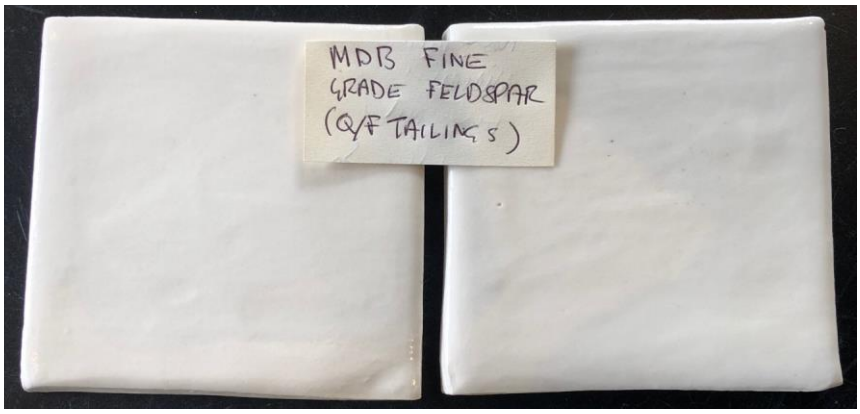
- Mina do Barroso Fine Grade Feldspar = Quartz / Feldspar Tailings (bulk tail to be produced from the spodumene concentrator)
- Mina do Barroso High Grade Feldspar = Refined Feldspar (separated product from the bulk tail)
- Mina do Barroso High Grade Quartz = Refined Quartz (separated product from the bulk tail)

A series of industrial application trials were then conducted on these products which are summarised in the tables below.

**CERAMICS:**

| Trial | Mina do Barroso Product tested | Test product created | Test work conducted by | Benchmark sample used & supplier | Results and comments |
|---|---|---|---|---|---|
| Vitrification | Fine Grade Feldspar | Ceramic bead | Furlong Mills LTD, UK | Cornish Stone (formerly supplied by Goonyean Ltd, UK) | • Existing grades in commercial use for ceramic body and glaze formulations can be matched<br>• All firings showed a high level of whiteness, better than the benchmark grades used for comparison<br>• No dark specks, striations or inhomogeneity were found |
| | High Grade Feldspar | | | Forshammer and FFF, feldspar (Sibelco, Sweden) | |
| Glaze | High Grade Feldspar | Transparent glazes applied to porcelain tiles fired to 1250°C | Potterycrafts Ltd, UK | Glaze made from FFF (Sibelco, Sweden) | • No problems were encountered during the preparation and firing of the trial glaze (no bubbles, foaming or viscosity problems). |
| Bone China | Fine Grade Feldspar | Bone China bodies | Global Ceramics Materials (GCM), UK | Standard bone china body (containing feldspar from Imerys) | • Both Savannah Feldspars worked well within a traditional bone china body recipe.<br>• Minor changes to processing and body recipes could be made to suit the existing formulation and achieve the exact specification.<br>• GCM would consider further commercial scale trials subject to availability and price. |
| | High Grade Feldspar | | | | |
| Hotelware | High Grade Feldspar | Ceramic bowls | Furlong Mills Ltd, UK | Standard body containing Forshammer feldspar (Sibelco, Sweden) | • No problems were encountered throughout the production process and the trial bowls matched the standard in all aspects: appearance, shape, contraction and colour were all identical |
| | High Grade Quartz | | | Standard body containing Lochaline quartz (Gruppo Minerali, Italy & Pilkington, UK) | |

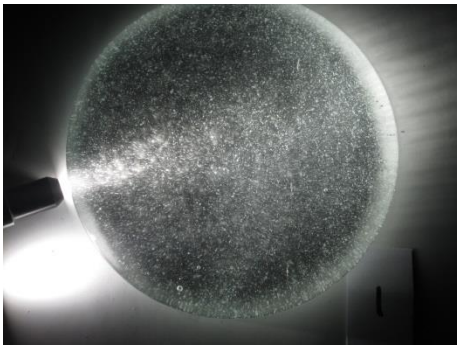
**Figure 1.** Mina do Barroso Fine Grade Feldspar Tiles produced from Tile Glaze Testing and Hotelware test and bowls produced from Mina do Barroso High Grade Feldspar

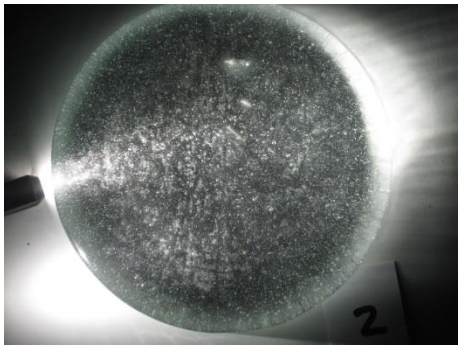



**GLASS:**

| Trial | Mina do Barroso Product tested | Test product created | Benchmark control used & test work conducted by | Results and comments |
|---|---|---|---|---|
| Container glass | High Grade Feldspar<br>High Grade Quartz | Standard grade container glass for regular commercial use | Regular commercial grade samples (Glass Technology Services, UK) | • The glass melt samples matched or exceeded the benchmark in quality, showing no problems with seed, bubbles, cord or inhomogeneity |
| Float Glass | High Grade Feldspar | Standard grade float glass for regular commercial use | | • The glass melt samples matched or exceeded the benchmark in quality, showing no problems with seed, bubbles, cord or inhomogeneity |
| Lead Crystal Glass | High Grade Quartz | Standard grade lead crystal glass for regular commercial use | | • The glass melt samples matched or exceeded the benchmark in quality, showing no problems with seed, bubbles, cord or inhomogeneity |

**Figure 2.** Flint Container Glass – Benchmark Comparative side lit images of (1) Flint container with Feldspar and (2) Flint container with Savannah Feldspar showing comparative levels of melting and refining



**About First Test Minerals**

The ceramics test work programme described previously was designed and managed by First Test Minerals using certified laboratories in the United Kingdom and whose principles collectively have over 70 years of experience in the ceramics industry.

Owner/Director Frank Hart B.Sc. (combined honours in Geology & Chemistry) has extensive experience in industrial minerals gained through 40 years of direct involvement in technical evaluation and quality control. Frank has worked in the paper, glass and ceramics mining industry including 28 years in kaolin where he was the Technical Manager at Goonvean Ltd, responsible for all geological and chemical aspects of mining and refining from 5 open cast kaolin quarries and the last operating china stone quarry in the UK, for many years, the sole indigenous source of feldspar in the UK. He also managed a testing facility for other companies investigating new deposits. This included kaolin and halloysite samples from Canada, USA, Sweden, Korea, Australia and Africa. Talc, GCC and silica sands were also tested.

First Test Minerals works closely with marketing consultant Simon Warren F.I.M.M.M, who has 30 years of technical and commercial experience in industrial minerals, including kaolin, ball clays, feldspars and calcined kaolin. Simon has extensive technical knowledge of all aspects of ceramic manufacture and raw materials, former Chair of the Whitewares Division of IOM3 and current Fellow member together with Global knowledge of commercial aspects for ceramic raw materials: sales, pricing, logistics.

Simon has experience with a wide range of industrial applications including prepared ceramic body preparation, tableware (plastic, pressure casting, dust-pressing) and sanitaryware (traditional and pressure casting) and has previously been employed with English China Clays PLC, Imerys, Potterycrafts and Goonvean Ltd in senior managerial marketing roles. Simon has played an important role in assisting with the test work and providing market guidance and pricing of products.

**Technical Consultant**

In addition to First Test Minerals, Savannah utilised Dr. Ian Wilson, owner/Director of Ian Wilson Consultancy Ltd (BSc honours degree in Geology & Chemistry, MSc in Geochemistry and PhD) whom has had an extensive 45 years' experience in industrial minerals. From 1974-2001, Ian worked for English China Clays and Imerys on geological and project management activities world-wide, including more than 5 years as Project Manager and Managing Director of operations in Brazil, Spain, Sweden and China. He established his own consultancy company in 2001 and his experience spans the range from exploration and resource estimation to project development and production, and includes global and regional marketing for a wide variety of industrial minerals, including kaolin, halloysite, calcium carbonate (PCC and GCC), talc, bentonite, special clays, ball clays, feldspar, barytes, magnesite and others. Dr. Wilson has concentrated on minerals used in the ceramic, paper and oilfield industries.

**Competent Person Statement**

The information in this announcement that relates to exploration results is based upon information compiled by Mr Dale Ferguson, Technical Director of Savannah Resources Limited. Mr Ferguson is a Member of the Australasian Institute of Mining and Metallurgy (AusIMM) and has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as a Competent Person as defined in the December 2012 edition of the "Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves" (JORC Code). Mr Ferguson consents to the inclusion in the report of the matters based upon the information in the form and context in which it appears.

The information in this announcement that relates to ceramics is based upon information compiled by Dr Ian Wilson, Owner/Director of Ian Wilson Consultancy Ltd. Dr Wilson is a Member of Institute of Materials, Minerals and Mining (MIMMM) and has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as a Competent Person as defined in the December 2012 edition of the "Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves" (JORC Code). Dr Wilson consents to the inclusion in the report of the matters based upon the information in the form and context in which it appears.

This announcement contains inside information for the purposes of Article 7 of Regulation (EU) 596/2014.

****ENDS****

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For further information please visit www.savannahresources.com or contact:


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**About Savannah**

Savannah is a diversified resources group (AIM: SAV) with a portfolio of energy metals projects - lithium in Portugal and copper in Oman - together with the world-class Mutamba Heavy Mineral Sands Project in Mozambique, which is being developed in a consortium with the global major Rio Tinto. The Board is committed to serving the interests of its shareholders and to delivering outcomes that will improve the

lives of the communities we work with and our staff.

The Company is listed and regulated on AIM and the Company's ordinary shares are also available on the Quotation Board of the Frankfurt Stock Exchange (FWB) under the symbol FWB: SAV, and the Börse Stuttgart (SWB) under the ticker "SAV".