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Supplement of

Physical and chemical properties of deposited airborne particulates over the Arabian Red Sea coastal plain

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Supplement A

Sampling Sites Meta-data

5 The NEO sampling site (DT3, DT4) is within a fenced area about 200 m in length and 50 m in width, situated along the southeastern border of the KAUST campus. The soil surface is covered by a layer of gravel and paved walkways, to contain local dust emissions. The Frisbee deposition samplers as well as several experimental photovoltaic (PV) and meteorological systems are installed at the NEO site. Besides the regional dust, the site is impacted by local emissions from vehicles traveling along the paved road to the south and in the paved parking lot to the north. Depending on the wind, the site was periodically exposed to dirt road and construction dust from building activities immediately outside the
10 KAUST campus.

The CMOR sampling site (DT3) is on a concrete paved quay about 200 m in length and 50 m wide, providing docking facilities for small and medium size boats in the KAUST harbor. The deposition sampler was set up close to the furthest edge of the quay, approximately 5m from the water's edge, about 1m above the water line, and approximately 65 m from the CMOR building entrance. The sampler is
15 exposed to local emissions from cargo loading activities and other traffic, as well as sea spray during stormy conditions.

One Frisbee sampler (DT1) was installed on the pebble covered flat garage rooftop of a residential home (G3705), located approximately 1.5 km to the beach area in the west and about 1 km from the harbor to the south. The site is impacted by local paved road traffic, a nearby bus terminal, and activities at a local shopping center. The sampler was set about 5m above the street level, and to some extent above street
20 level dust and local transport emissions.

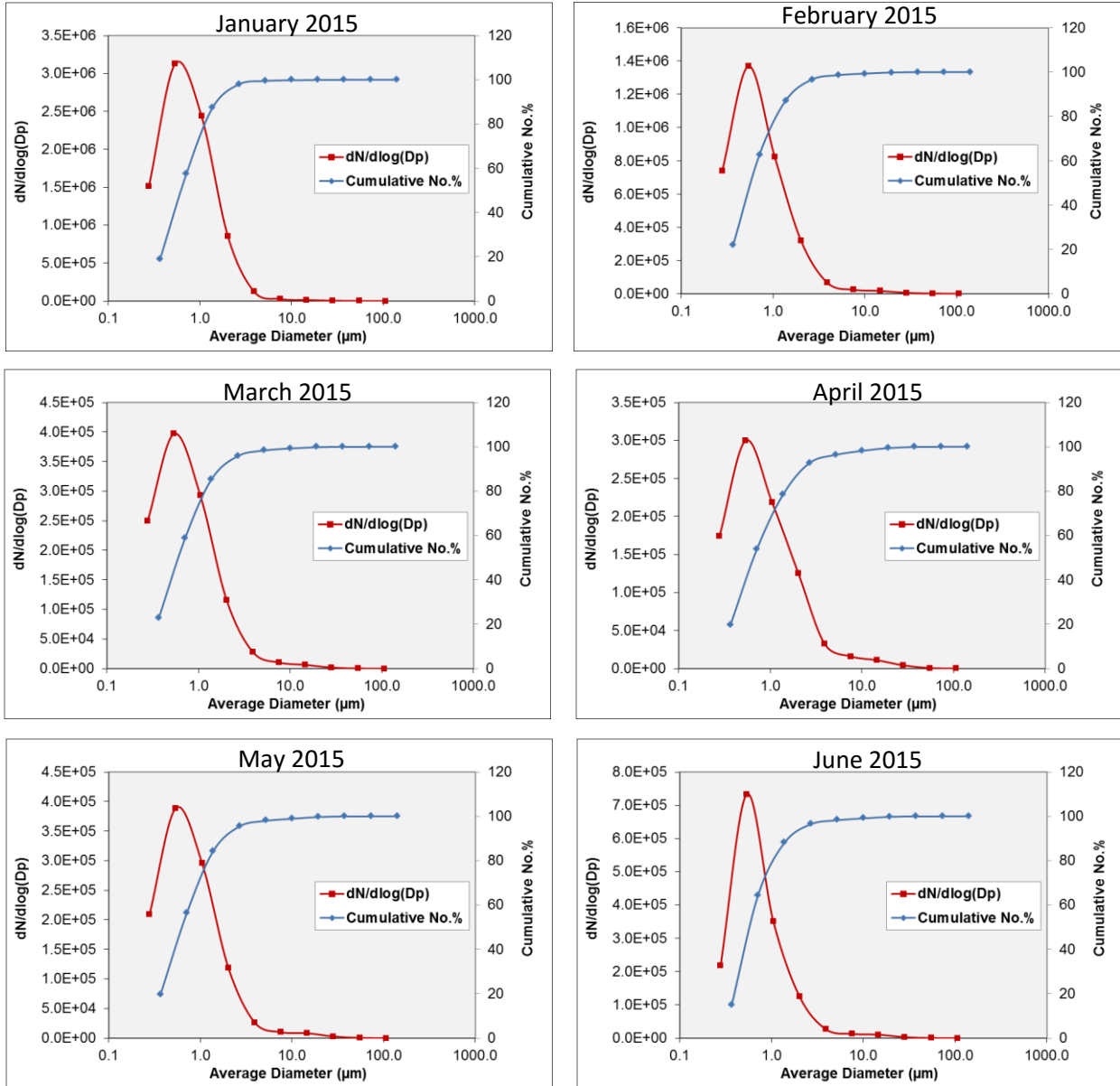
Supplement B

Dust Deposition on Solar Panels

Dust deposits on solar panels are known to have a severe detrimental effect on the efficiency of photovoltaic systems (Goossens and Van Kerschaever, 1999; Hamou et al., 2014; Mejia et al., 2014; Rao et al., 2014; Sulaiman et al., 2014; Ilse et al., 2016). High humidity is experienced at KAUST throughout the year, more often during the late summer months of July to September. This is reflected by dew being formed on radiating cool surfaces such as solar panels, as well as coastal fog during the early morning hours. The gypsum component of dust being collected by the Frisbee samplers and on all exposed surfaces is being partly dissolved by the dew, and on drying being recrystallized. XRD measurements performed directly on dust collected on zero background silicon wafers exposed over a period of several months showed the dust surface to be hardened by the crystallization of blades of gypsum. These surface crusts of gypsum were shown to have a distinct preferred orientation, having their (010) crystal planes parallel to the surface of the silicon wafer, as will be the case on other flat surfaces. The cementation of dust on glass surfaces by gypsum encrustation increases the adhesion of dust on the solar panels, and a resultant attenuation of solar panel efficiency. Dust mineralogy and mineralogical interrelationships, together with climatic conditions are variables determining the nature of dust deposits on solar panels. This needs to be understood with the planning and placement of solar arrays.

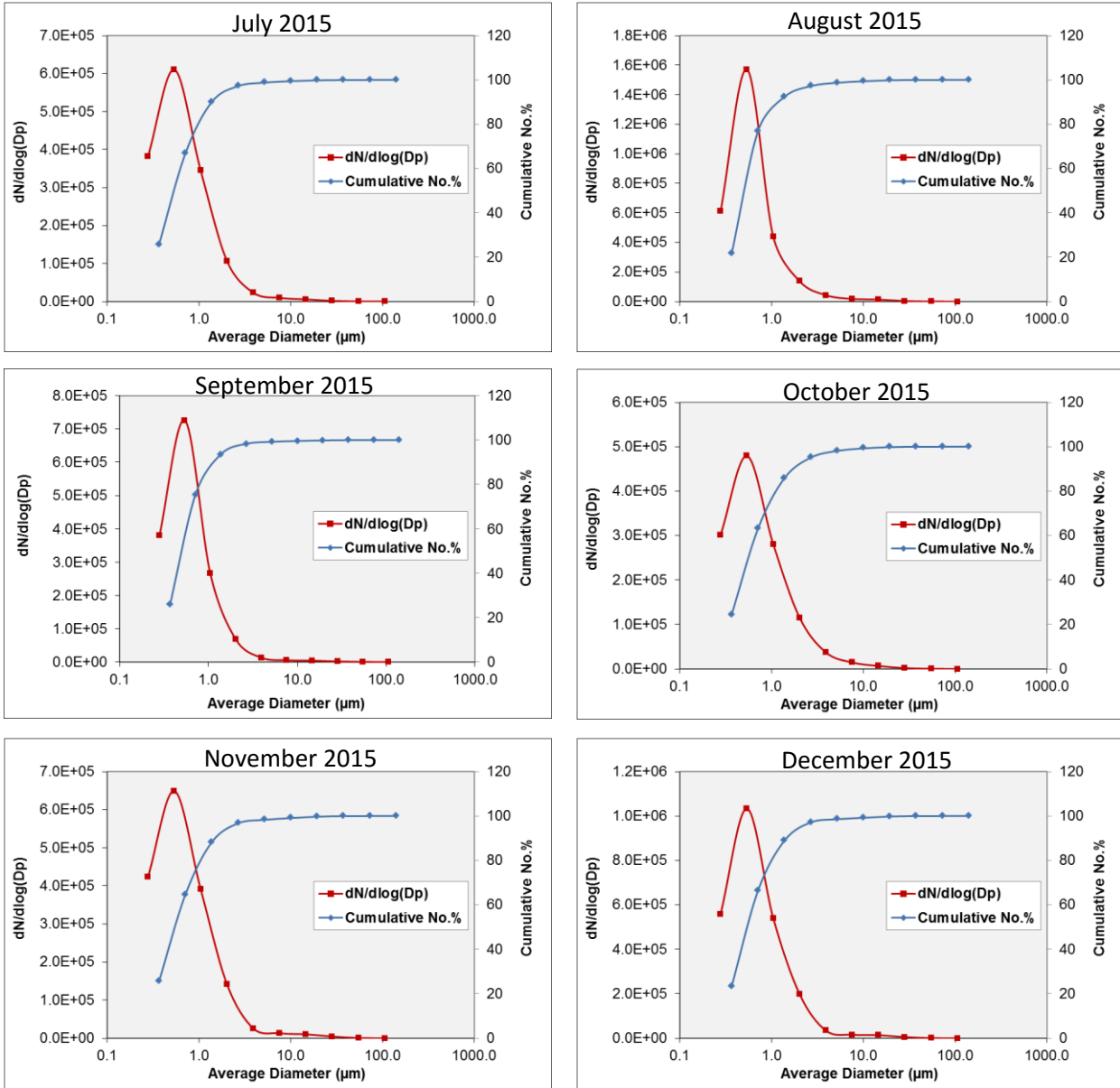
Supplement C

SEM based particle number distribution curves for 12 months of 2015



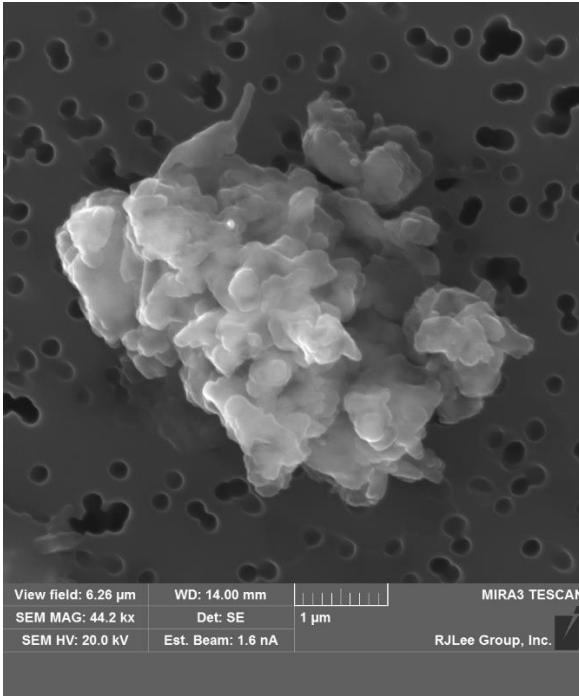
Supplement C

SEM based particle number distribution curves for 12 months of 2015

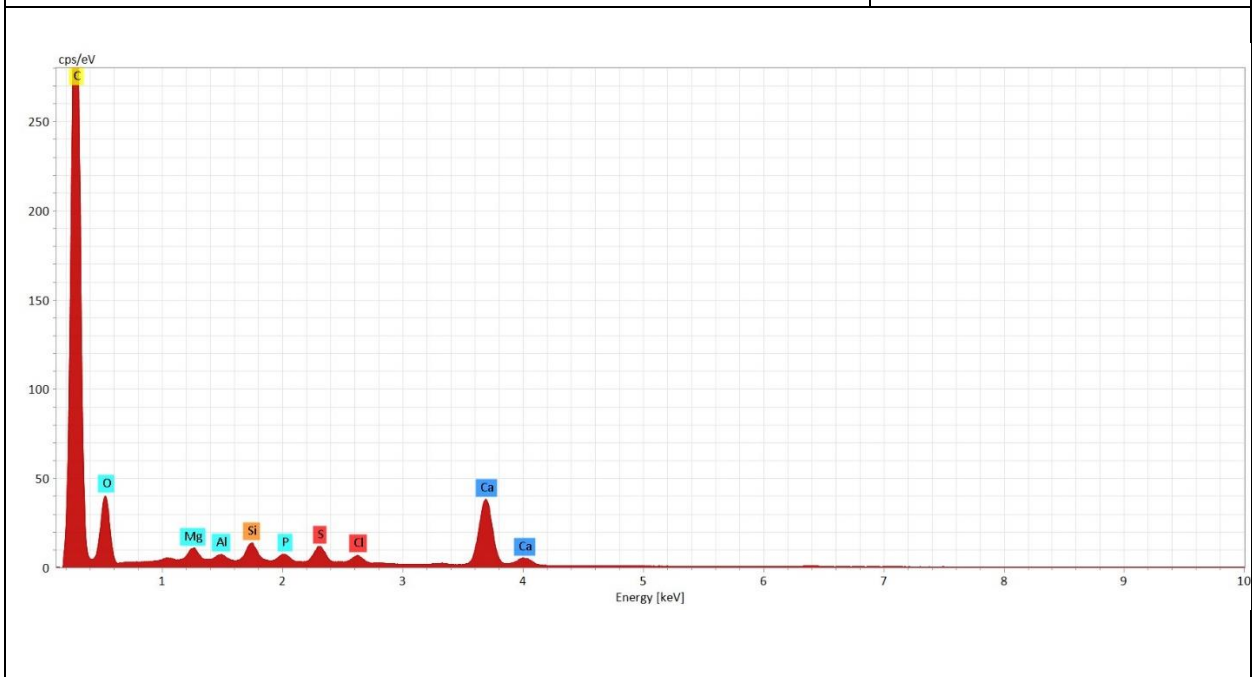


Supplement D

SEM based Secondary Electron Images

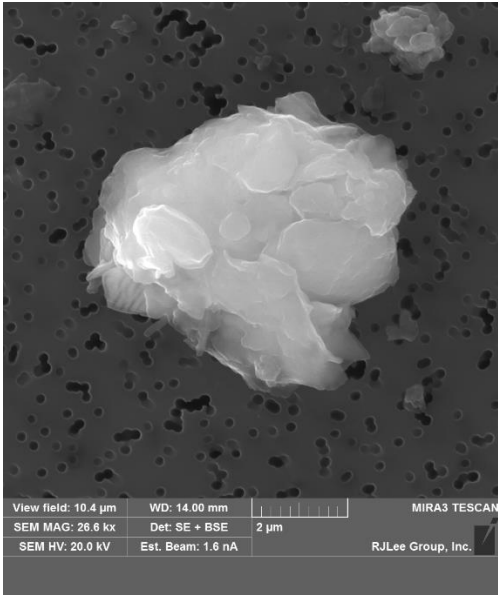


DT3.1 012015
January 2015
Image 01
Calcite cluster with minor
amounts of clay, gypsum,
halite and apatite?

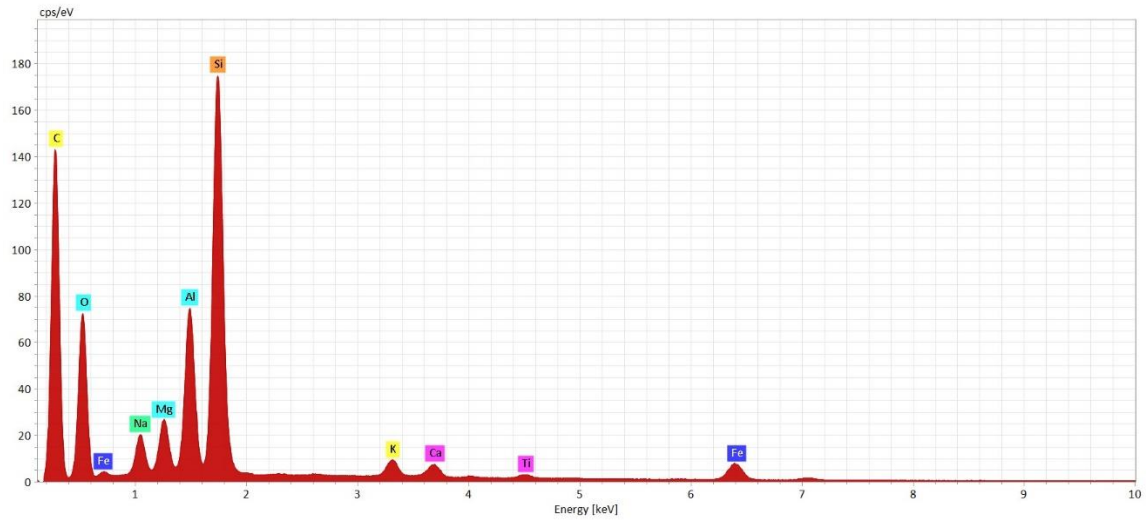


Supplement D

SEM based Secondary Electron Images

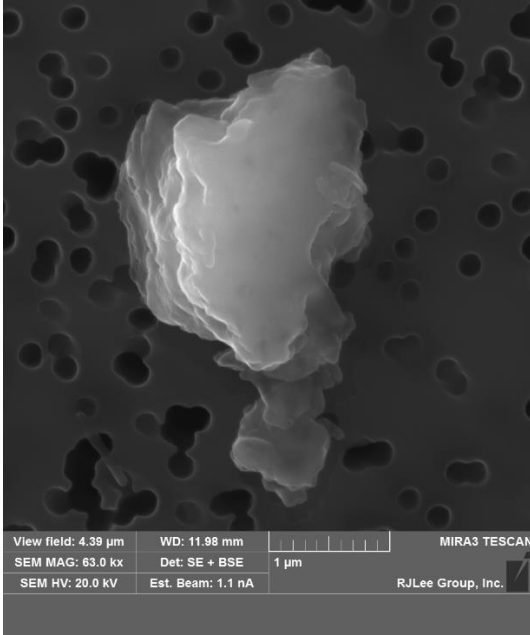


DT3.1 012015
January 2015
Image 02
Illite clay with minor amounts of halite and calcite?

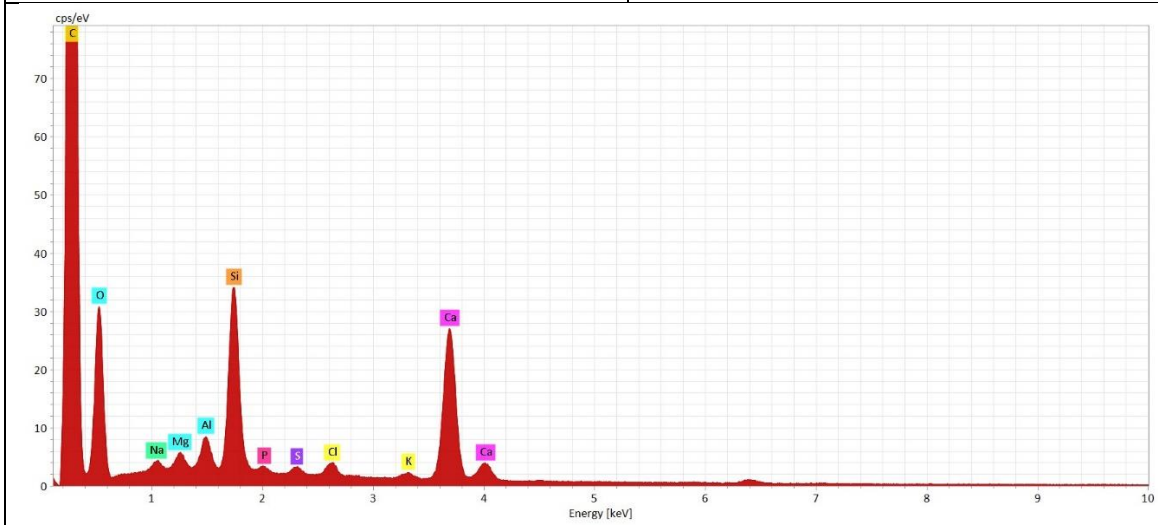


Supplement D

SEM based Secondary Electron Images

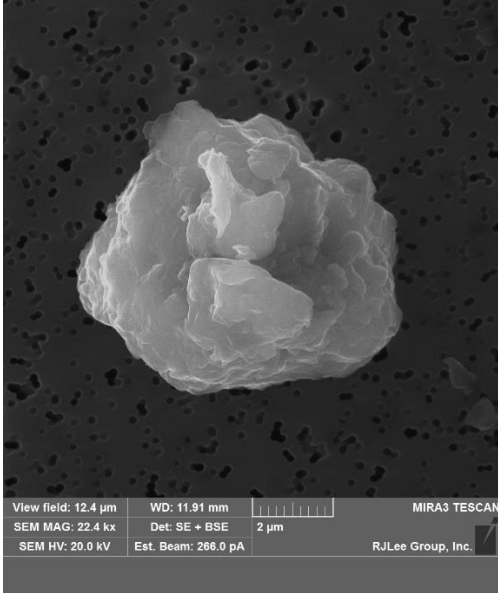


DT3.1 012015
January 2015
Image 03
Clay and calcite with minor amounts of quartz,
halite, gypsum, and apatite?

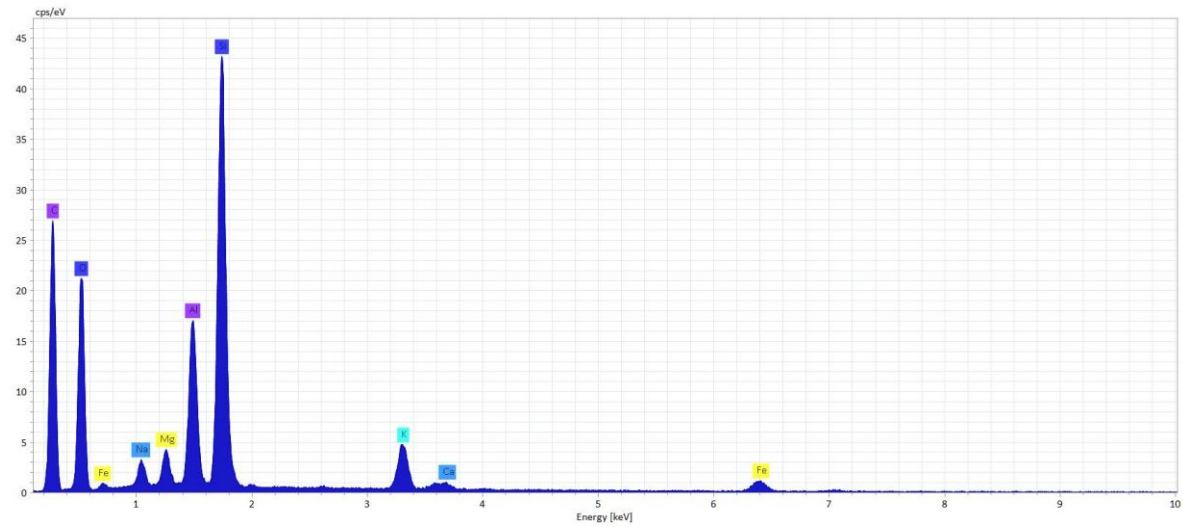


Supplement D

SEM based Secondary Electron Images

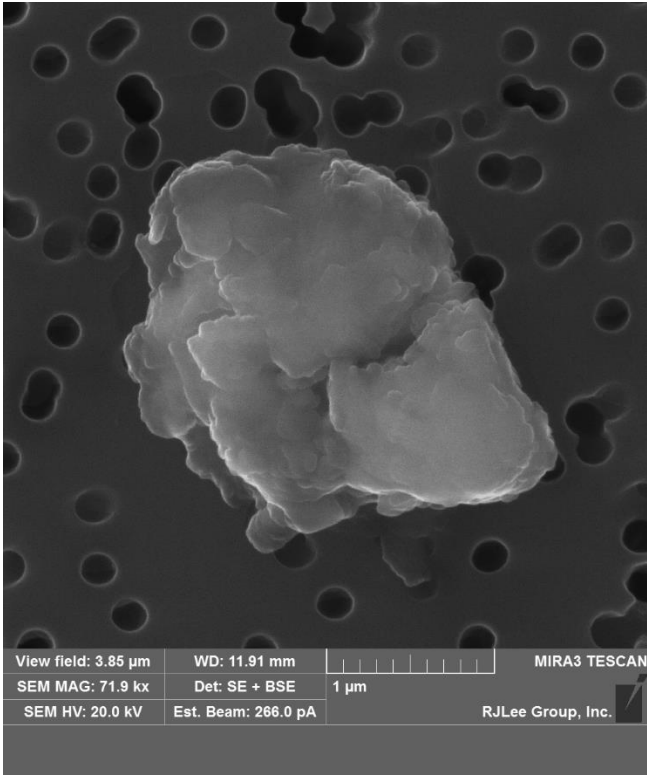


DT3.1 022015
February 2015
Image 01
Clay with minor amounts of halite and calcite?

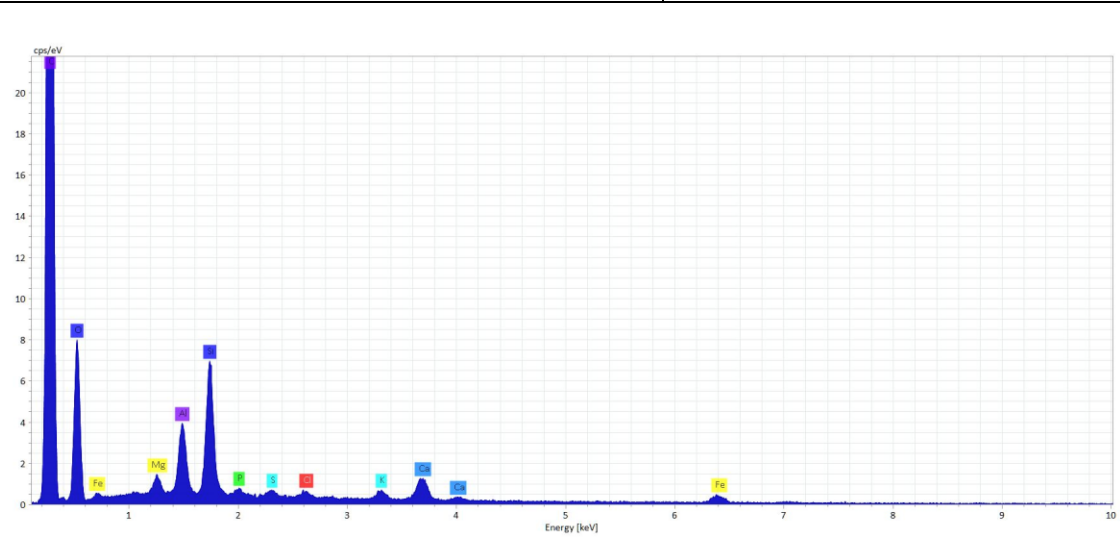


Supplement D

SEM based Secondary Electron Images

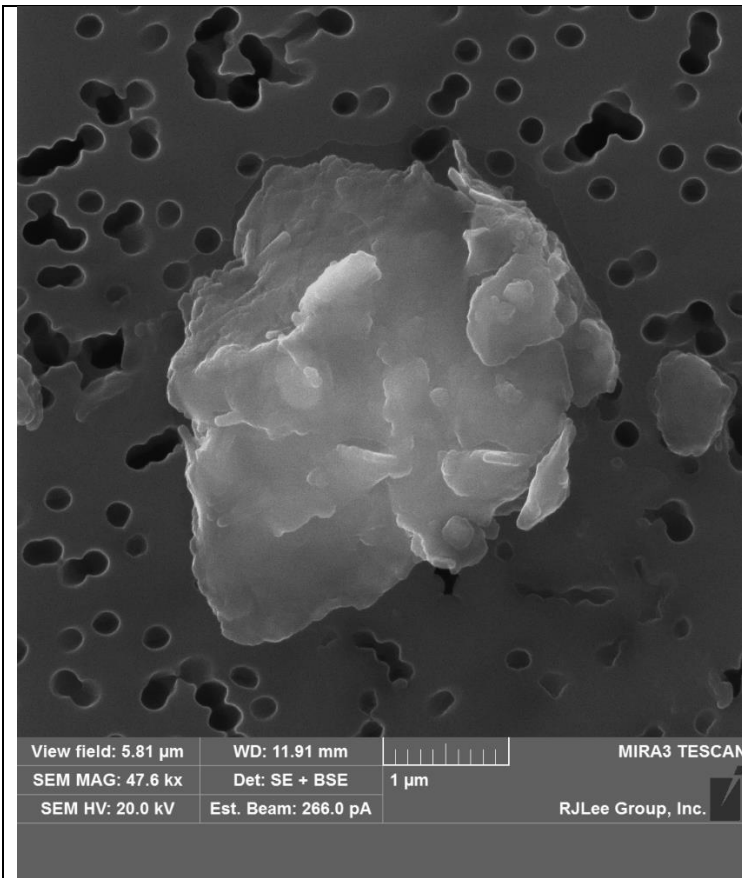


DT3.1 022015
February 2015
Image 02
Clay and calcite with minor amounts of
gypsum, apatite and halite ?

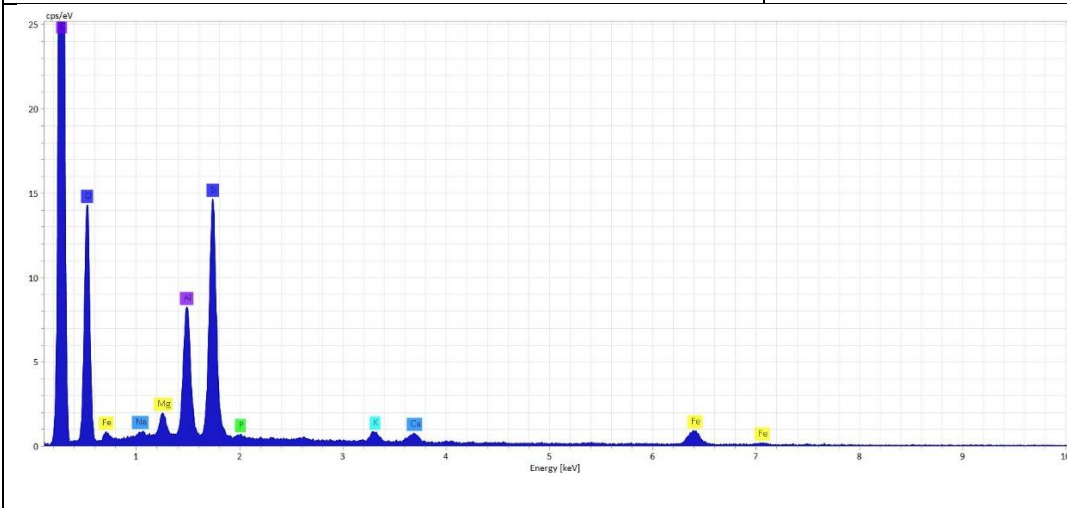


Supplement D

SEM based Secondary Electron Images

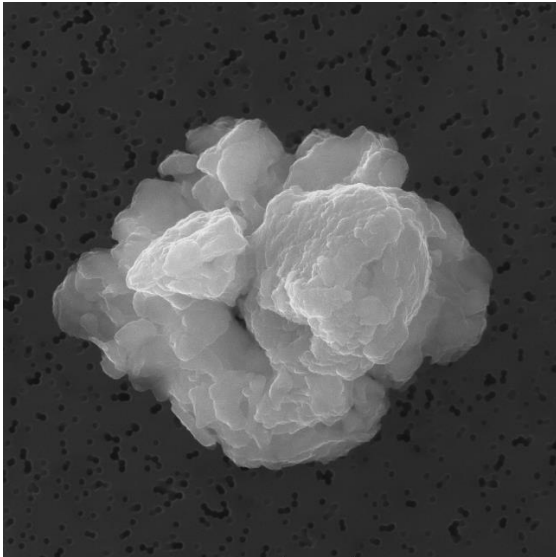


DT3.1 022015
February 2015
Image 03
Clay with minor amounts of calcite,
halite and apatite?



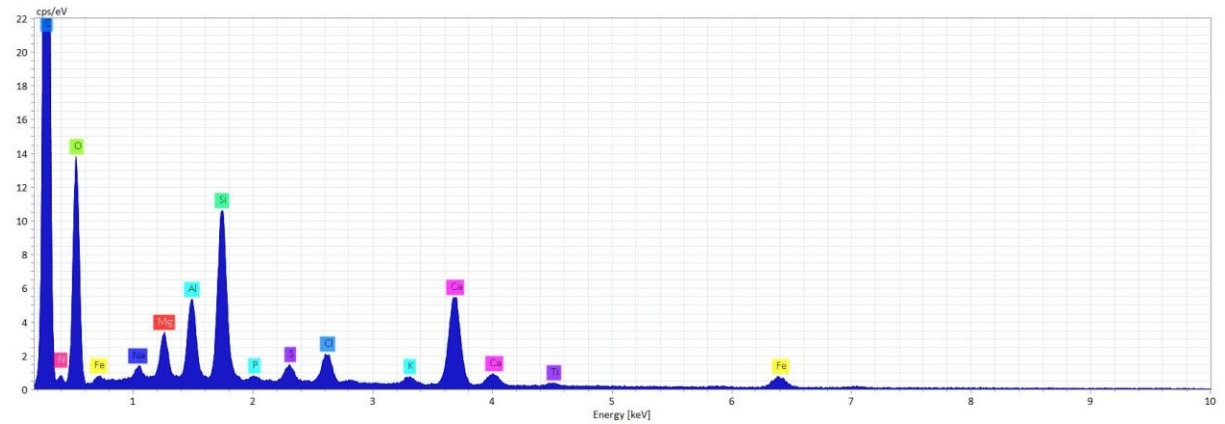
Supplement D

SEM based Secondary Electron Images



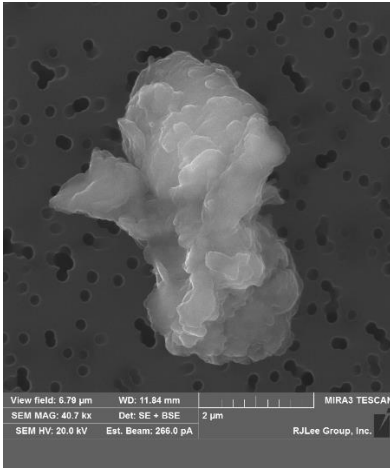
View field: 15.5 μm WD: 11.84 mm MIRA3 TESCAN
SEM MAG: 17.9 kx Det: SE + BSE 2 μm
SEM HV: 20.0 kV Est. Beam: 286.0 pA RJLee Group, Inc.

DT3.4 032015
March 2015
Image 01
Clay, calcite and halite with
minor amounts of gypsum
and apatite?

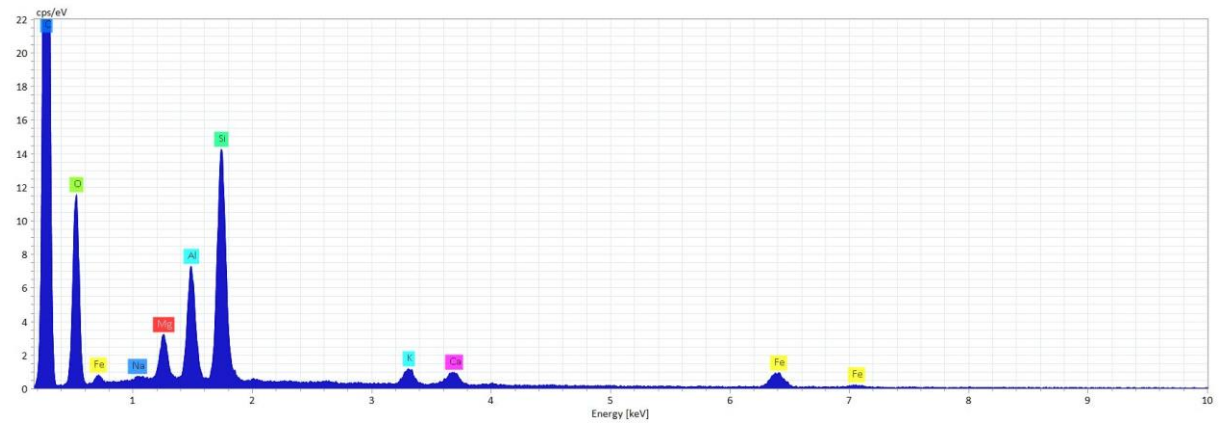


Supplement D

SEM based Secondary Electron Images

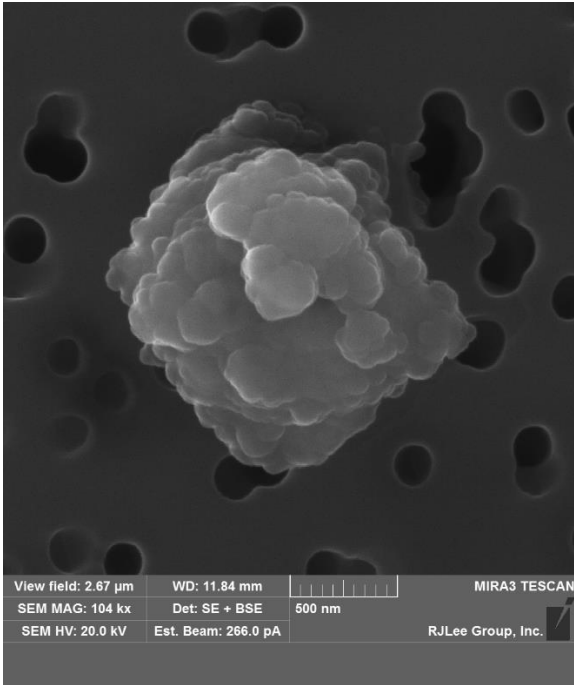


DT3.4 032015
March 2015
Image 02
Clay with minor amounts of calcite and halite?

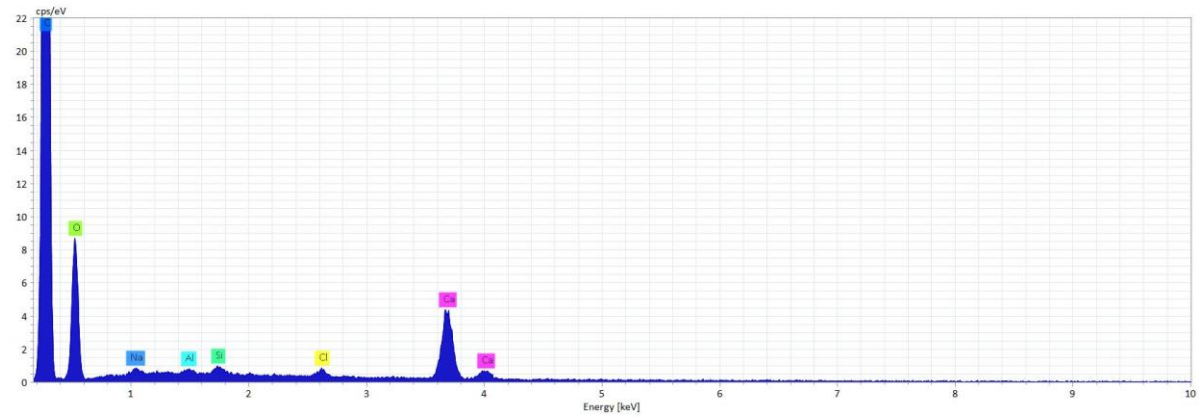


Supplement D

SEM based Secondary Electron Images

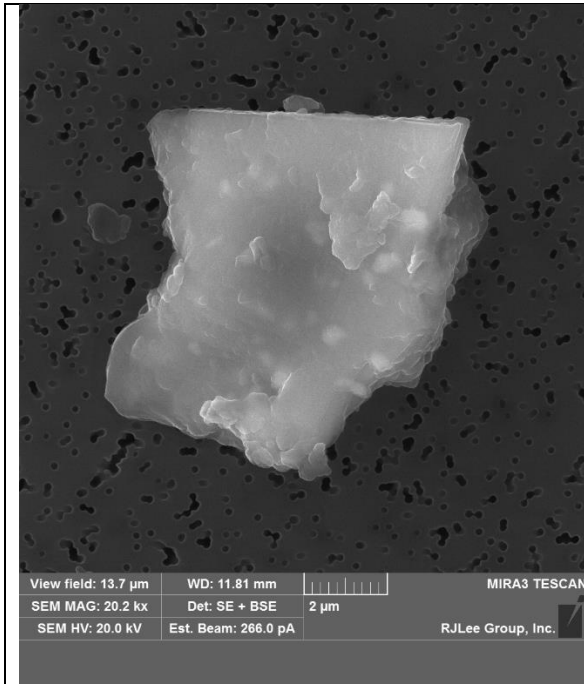


DT3.4 032015
March 2015
Image 03
Calcite cluster with minor amounts of clay and halite?

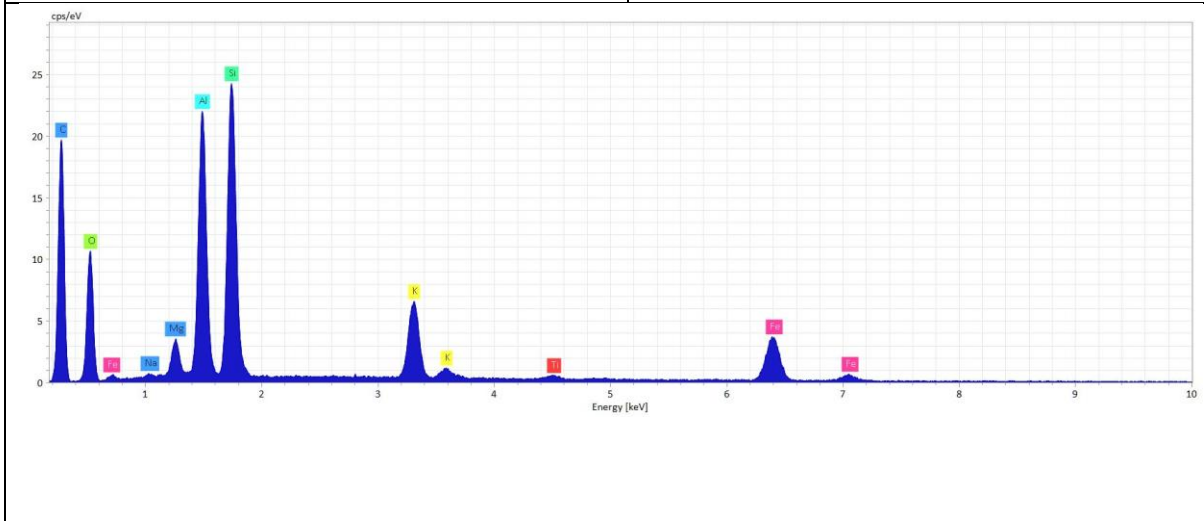


Supplement D

SEM based Secondary Electron Images

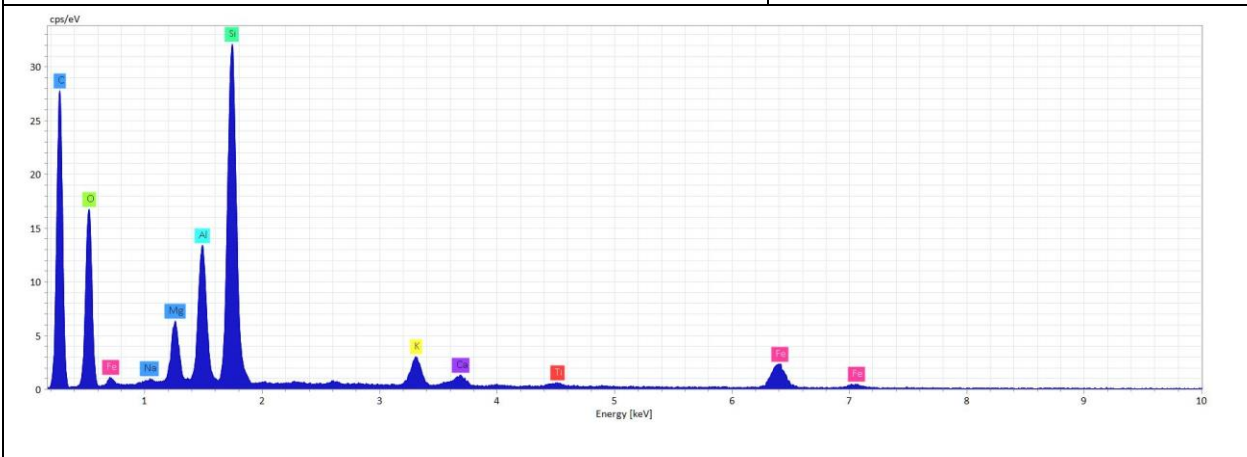
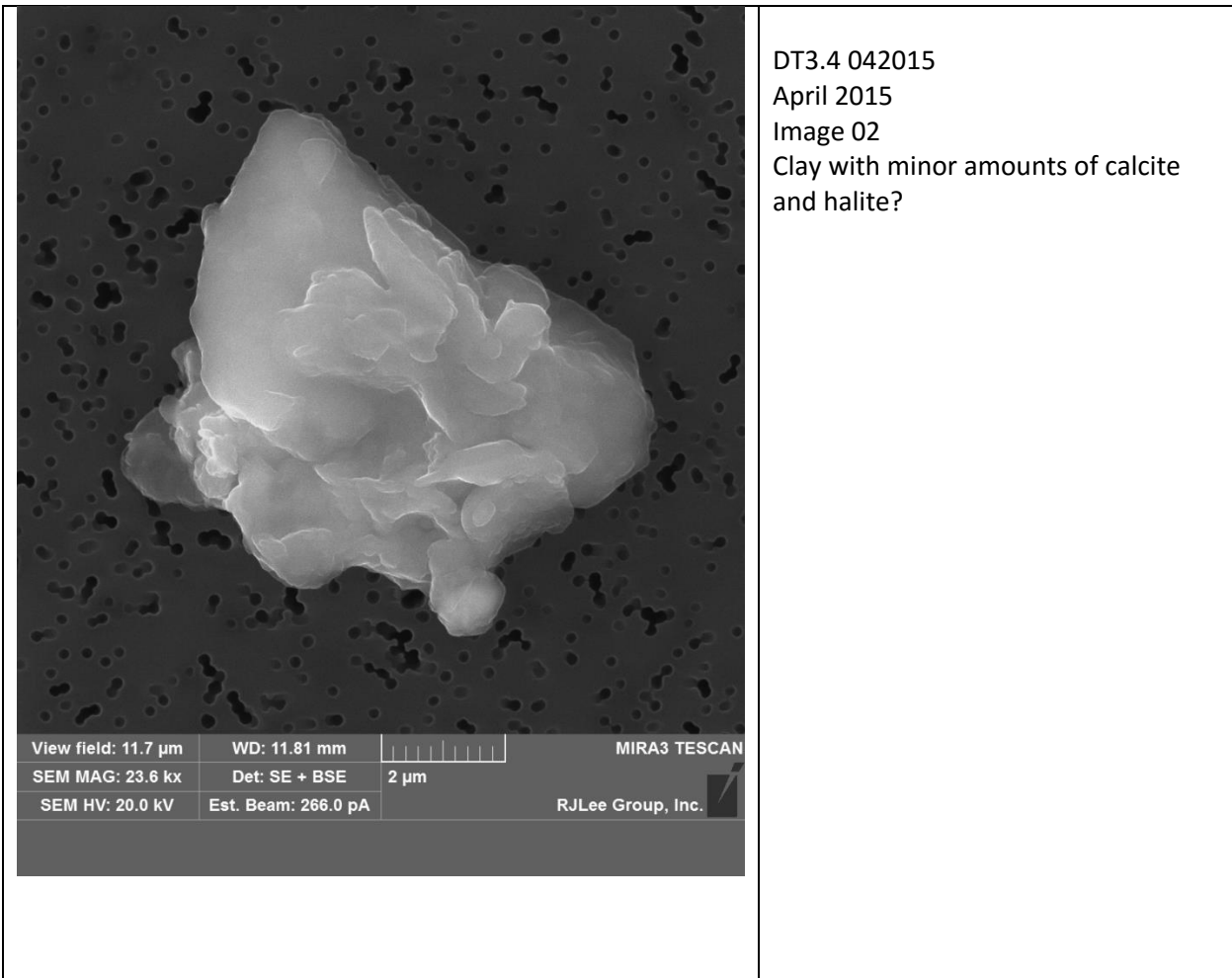


DT3.4 042015
April 2015
Image 01
Potassium feldspar with clay and halite?



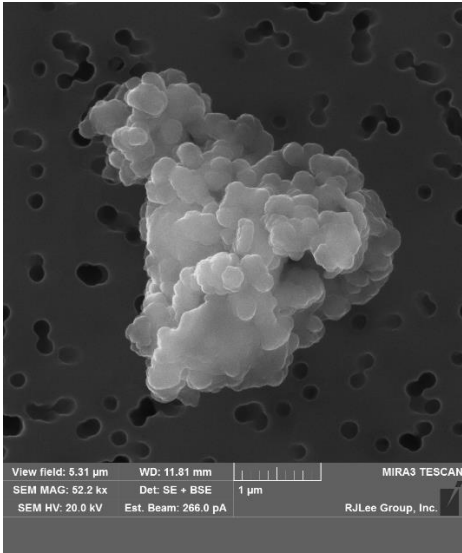
Supplement D

SEM based Secondary Electron Images



Supplement D

SEM based Secondary Electron Images

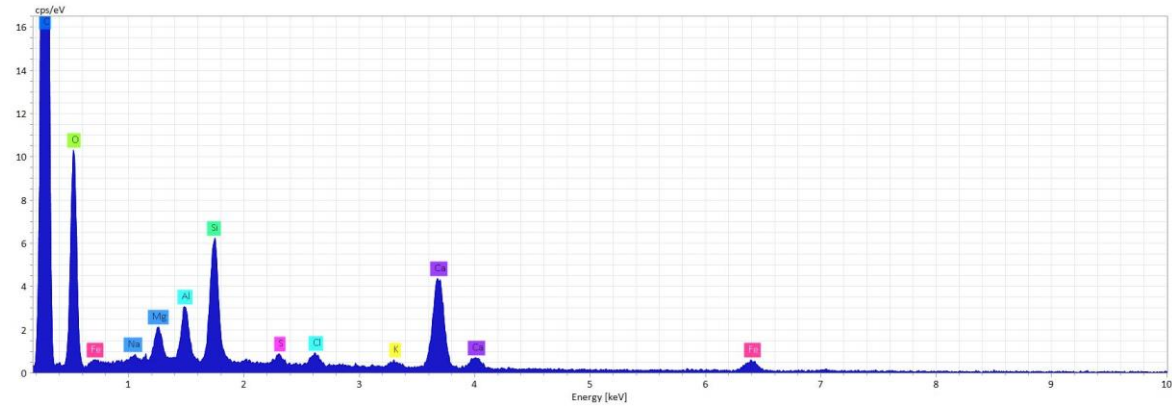


DT3.4 042015

April 2015

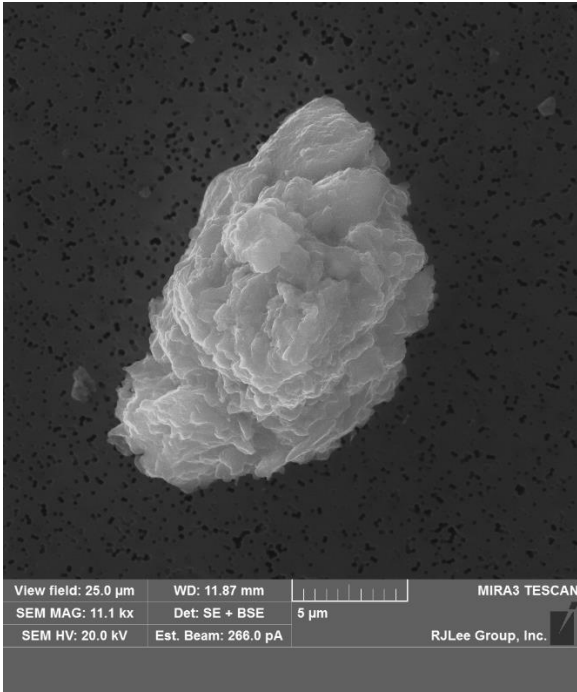
Image 03

Calcite and clay cluster with minor amounts of halite and gypsum?

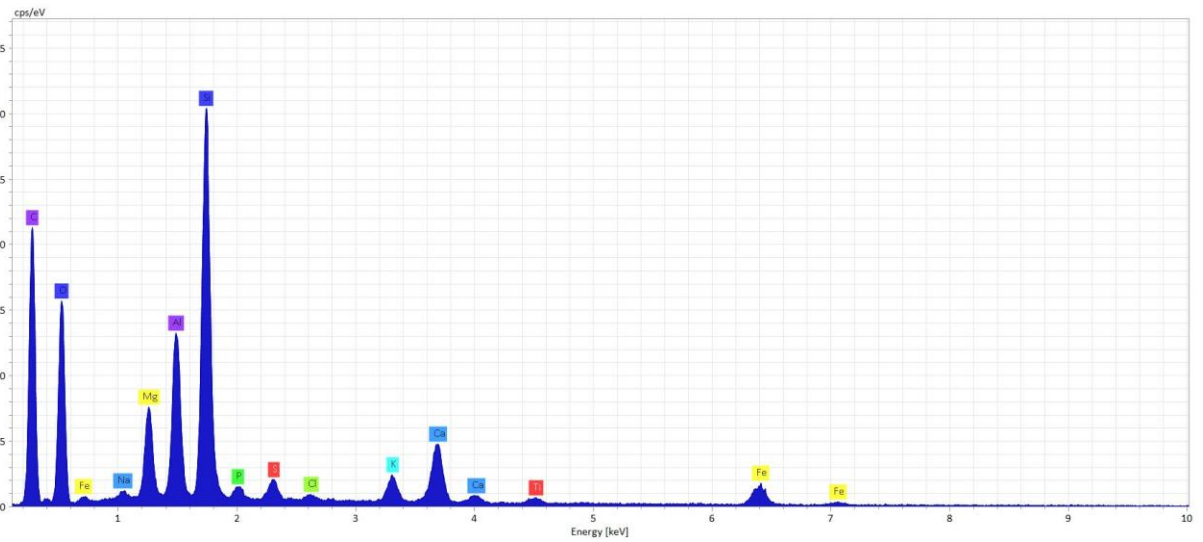


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SEM based Secondary Electron Images

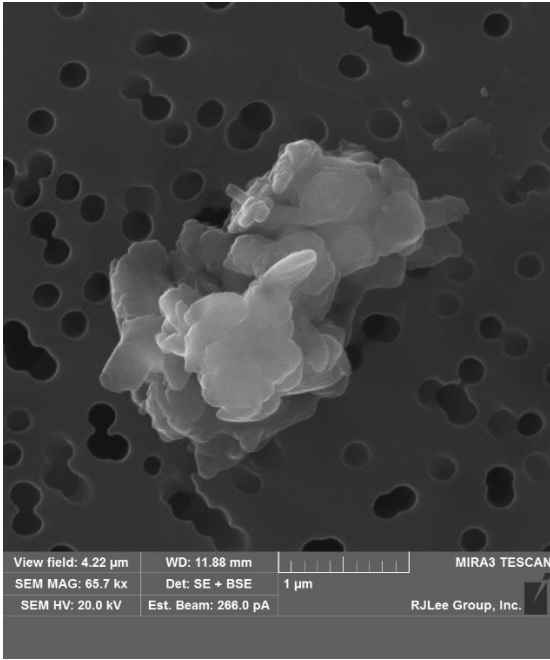


DT3.3 052015
May 2015
Image 01
Clay and calcite with minor
amounts of gypsum, halite
and apatite?

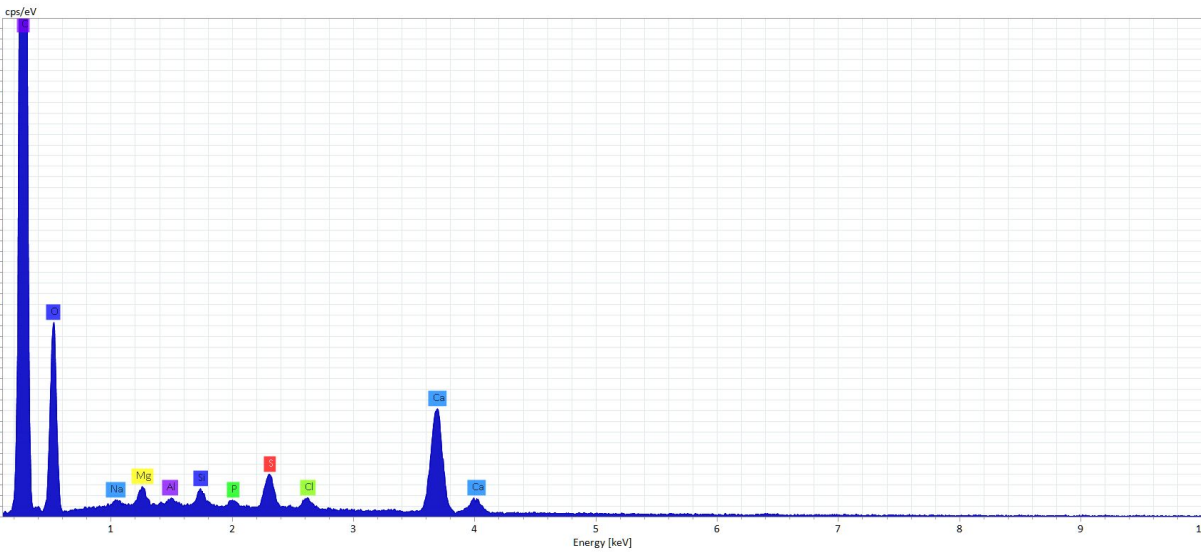


Supplement D

SEM based Secondary Electron Images

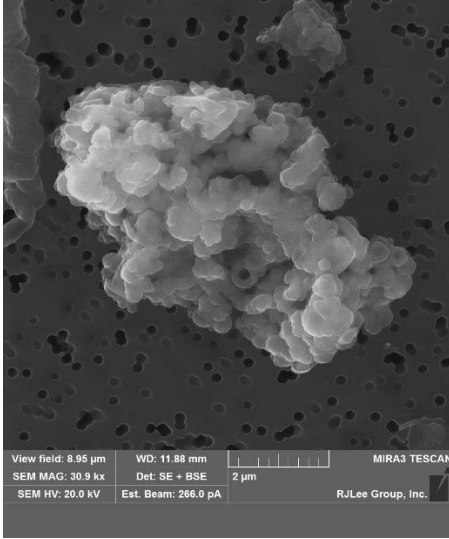


DT3.3 052015
May 2015
Image 02
Calcite with minor amounts of
gypsum halite and clay?

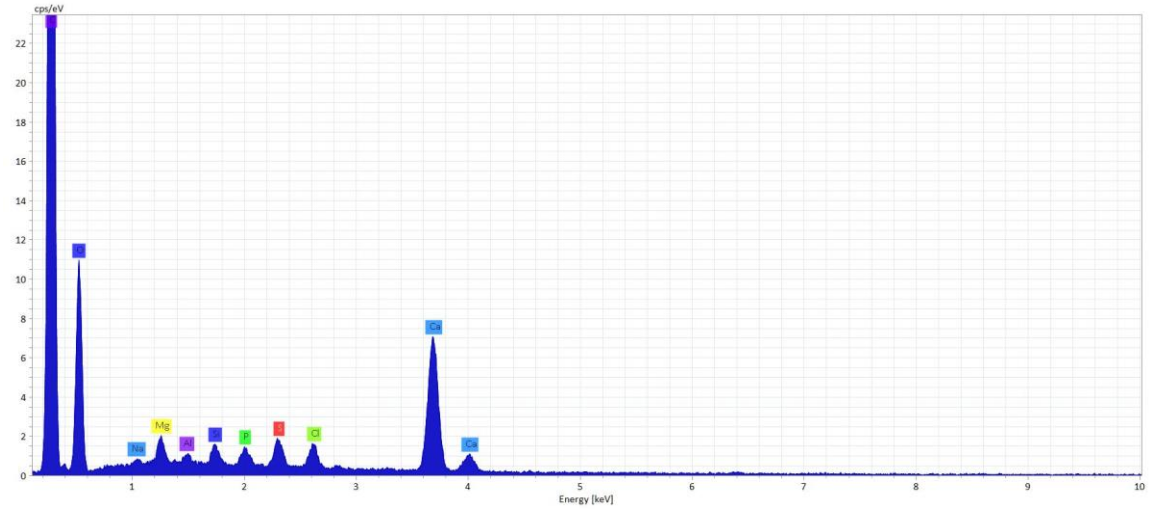


Supplement D

SEM based Secondary Electron Images

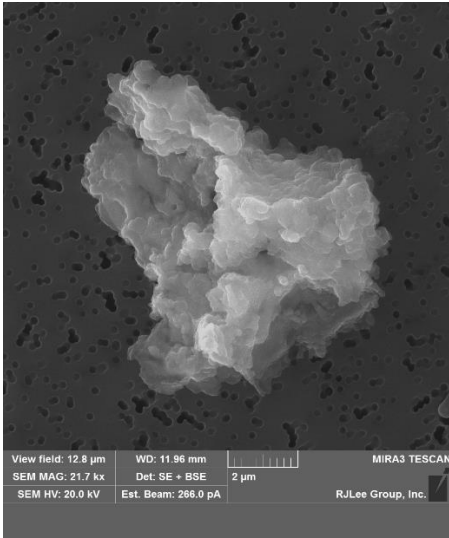


DT3.3 052015
May 2015
Image 03
Calcite cluster with minor amounts of gypsum,
clay, halite and apatite?

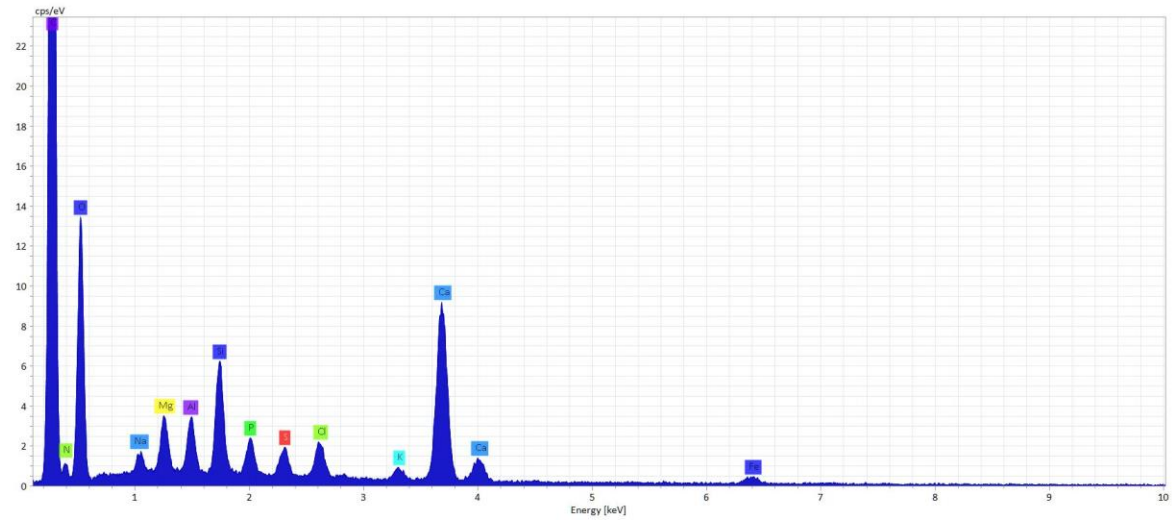


Supplement D

SEM based Secondary Electron Images

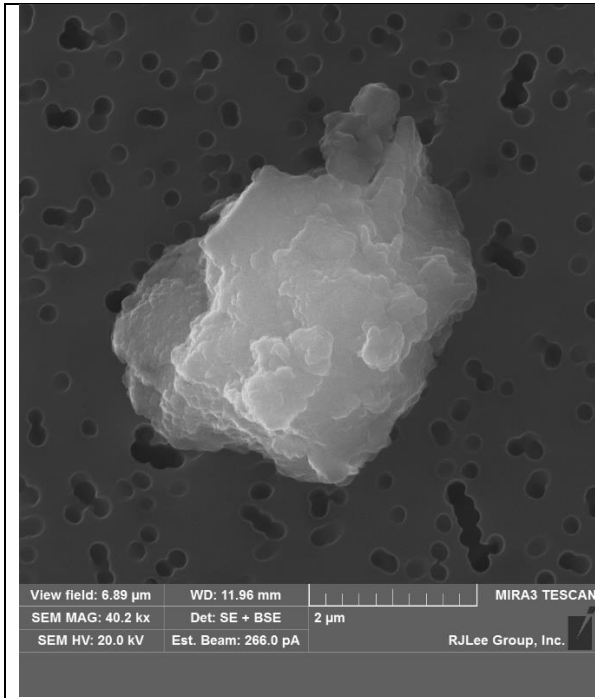


DT3.3 062015
June 2015
Image 01
Calcite & clay cluster, with minor amounts of
halite, gypsum and apatite?

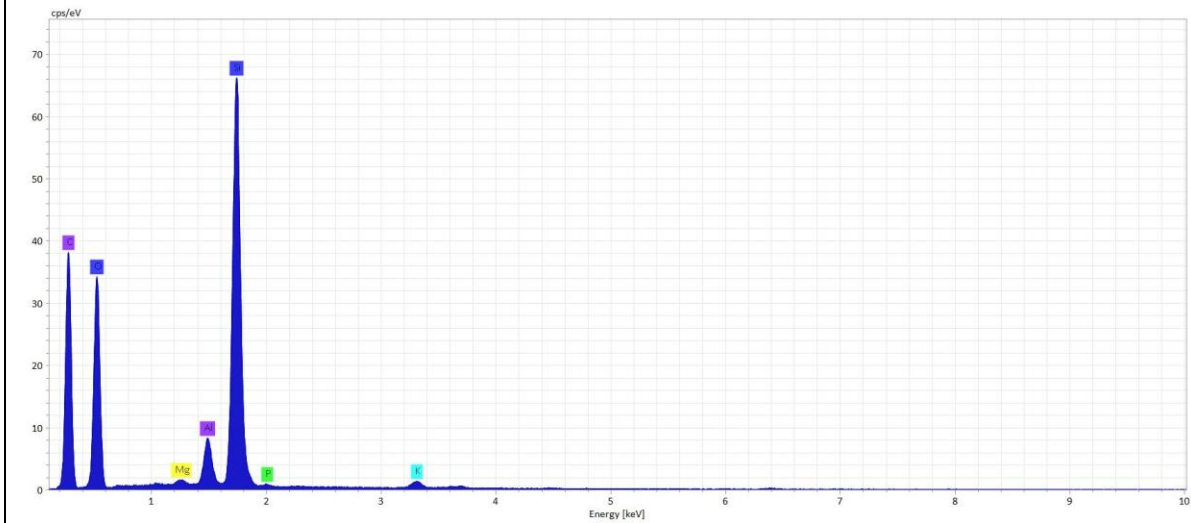


Supplement D

SEM based Secondary Electron Images

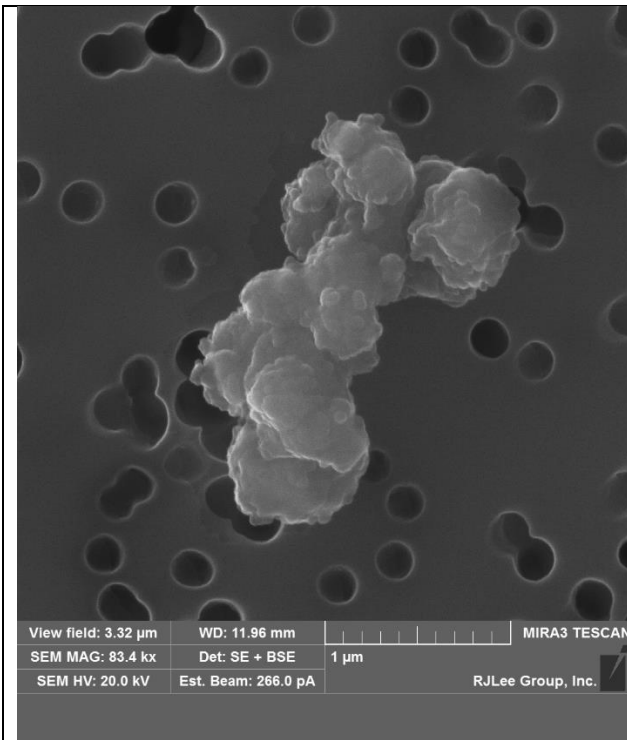


DT3.3 062015
June 2015
Image 02
Quartz with clay?

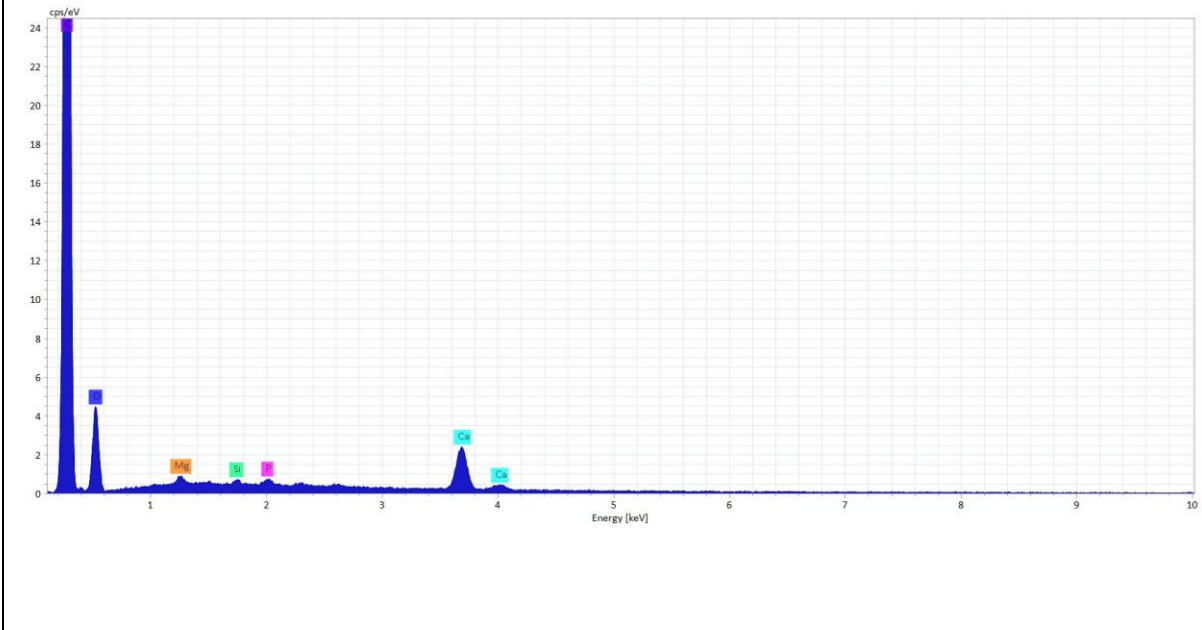


Supplement D

SEM based Secondary Electron Images

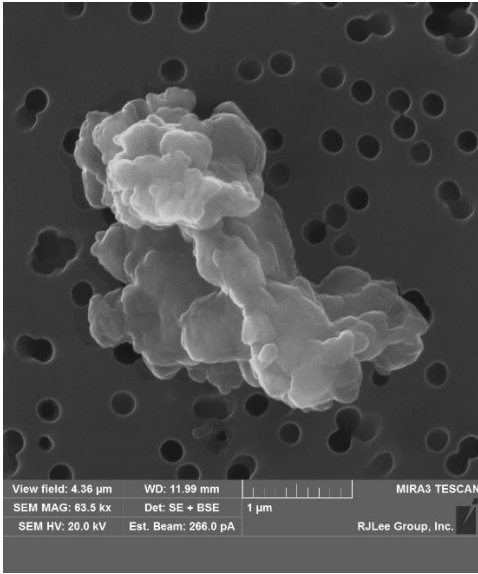


DT3.3 062015
June 2015
Image 03
Calcite cluster with minor clay and apatite?

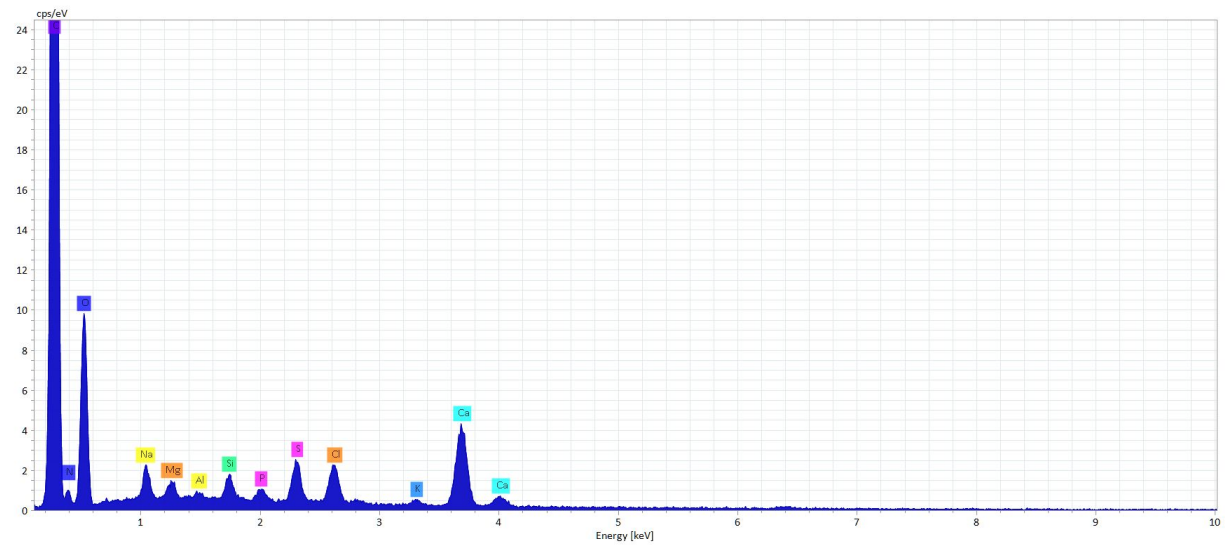


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SEM based Secondary Electron Images

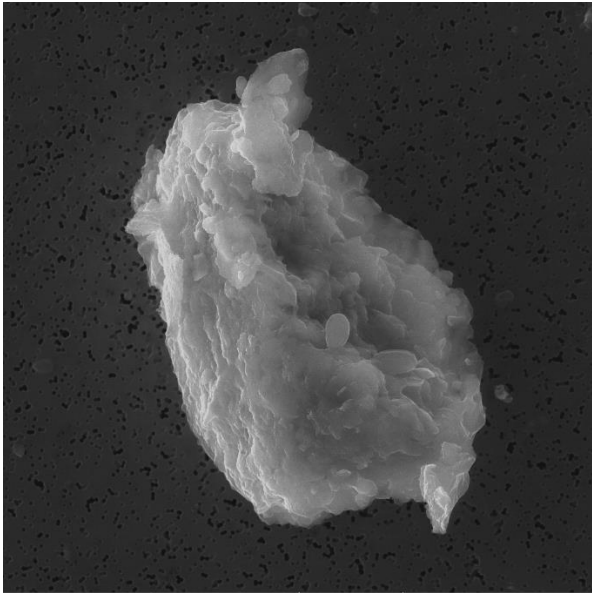


DT3.3 072015
July 2015
Image 01
Calcite & gypsum with minor
halite, clay and apatite?



Supplement D

SEM based Secondary Electron Images



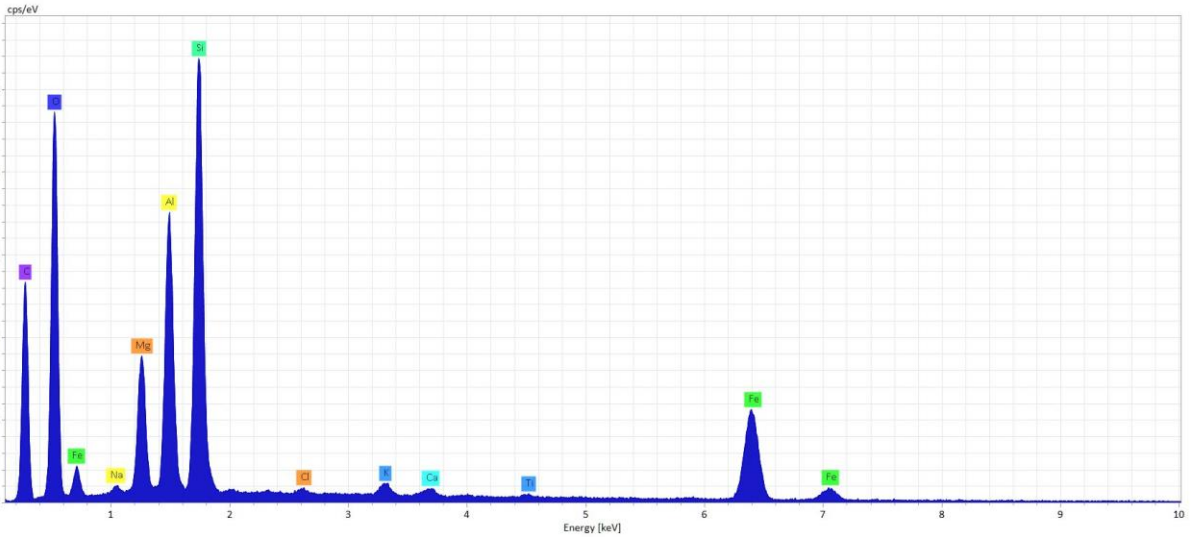
DT3.3 072015

July 2015

Image 02

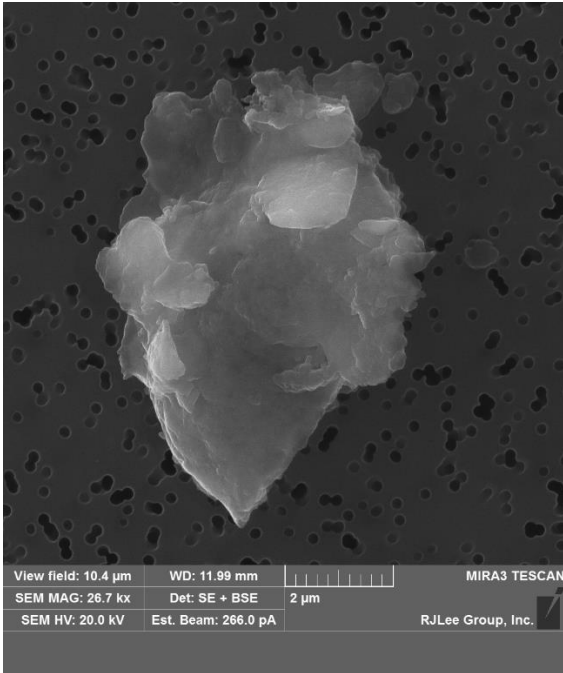
Clay & iron oxide cluster with minor amounts of calcite and halite?

View field: 28.4 μm	WD: 11.98 mm	MIRA3 TESCAN
SEM MAG: 9.73 kx	Det: SE + BSE	5 μm
SEM HV: 20.0 kV	Est. Beam: 266.0 pA	RJLee Group, Inc.

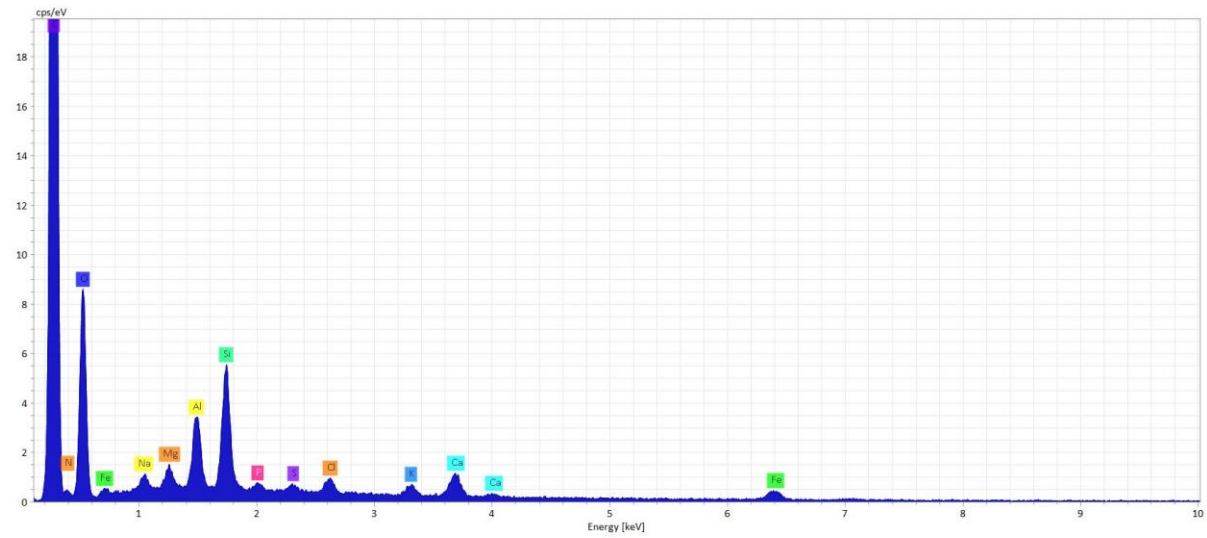


Supplement D

SEM based Secondary Electron Images

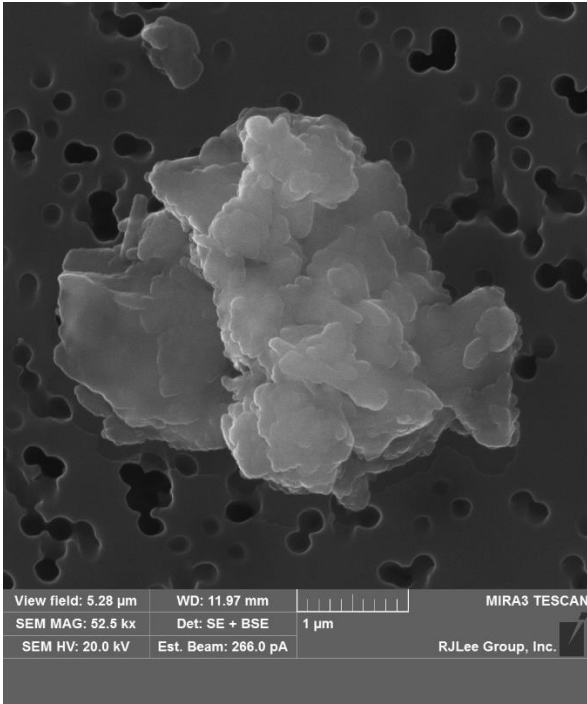


DT3.3 072015
July 2015
Image 03
Clay with minor amounts of calcite, gypsum,
halite and apatite?

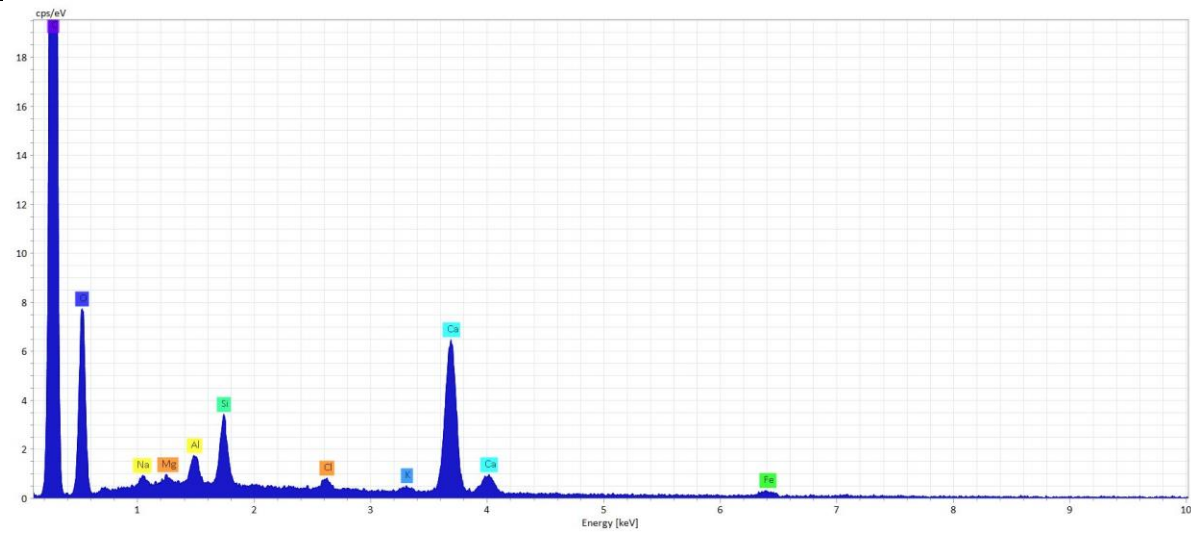


Supplement D

SEM based Secondary Electron Images

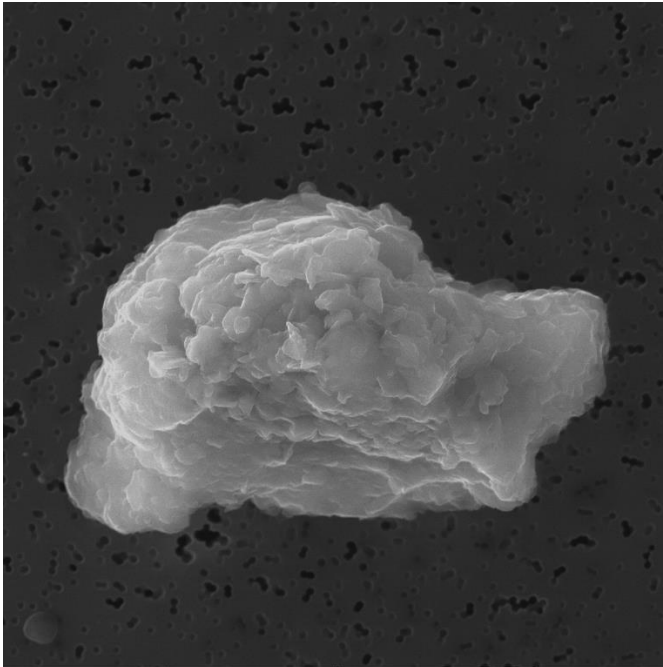


DT3.3 082015
August 2015
Image 01
Calcite & clay with minor amount of halite?



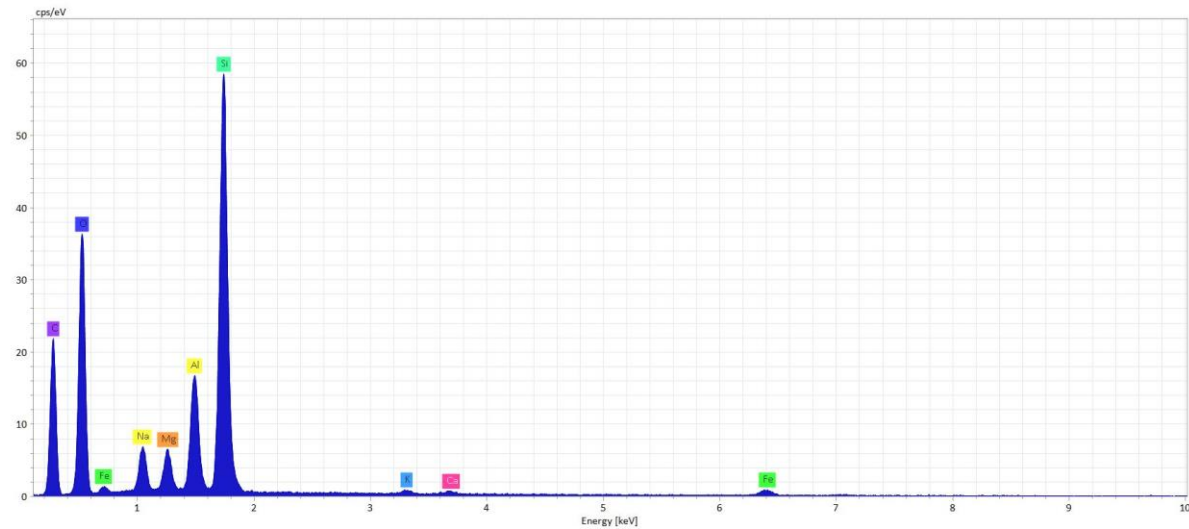
Supplement D

SEM based Secondary Electron Images



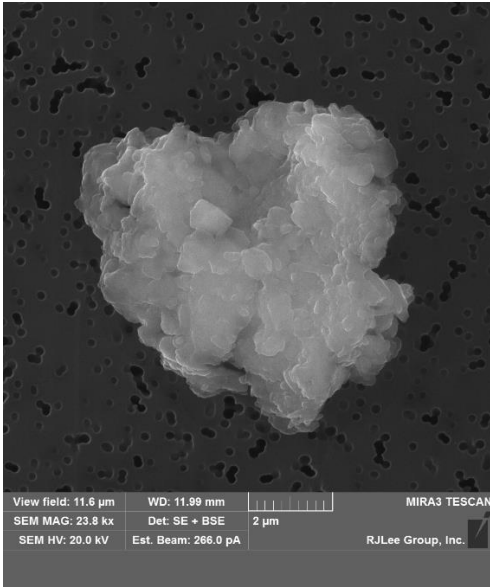
DT3.3 082015
August 2015
Image 02
Clay with minor amount of halite?

View field: 16.6 μm	WD: 11.97 mm	MIRA3 TESCAN
SEM MAG: 16.7 kx	Det: SE + BSE	5 μm
SEM HV: 20.0 kV	Est. Beam: 266.0 pA	RJLee Group, Inc.

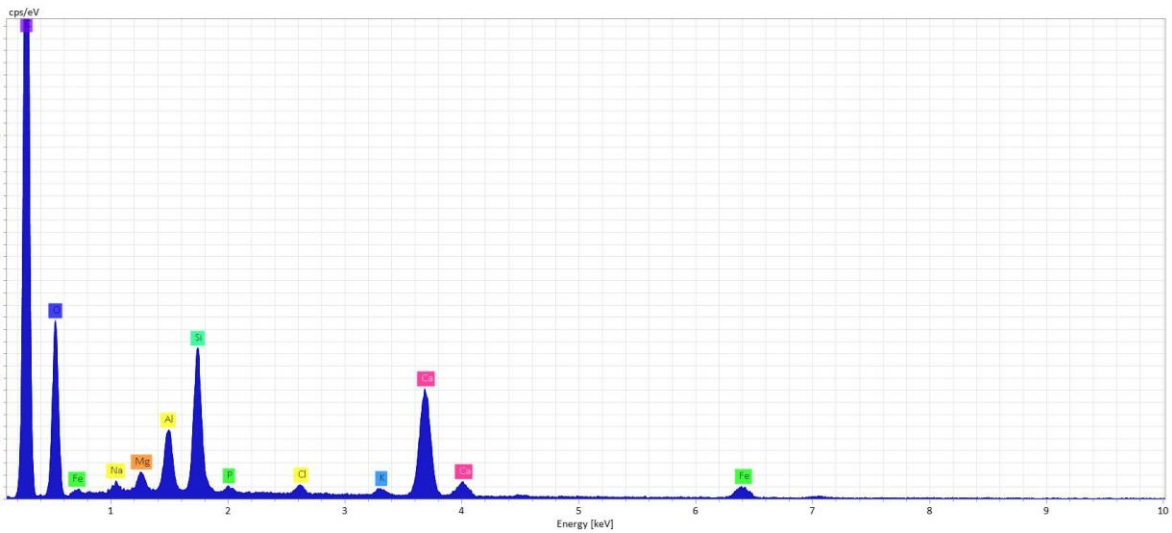


Supplement D

SEM based Secondary Electron Images

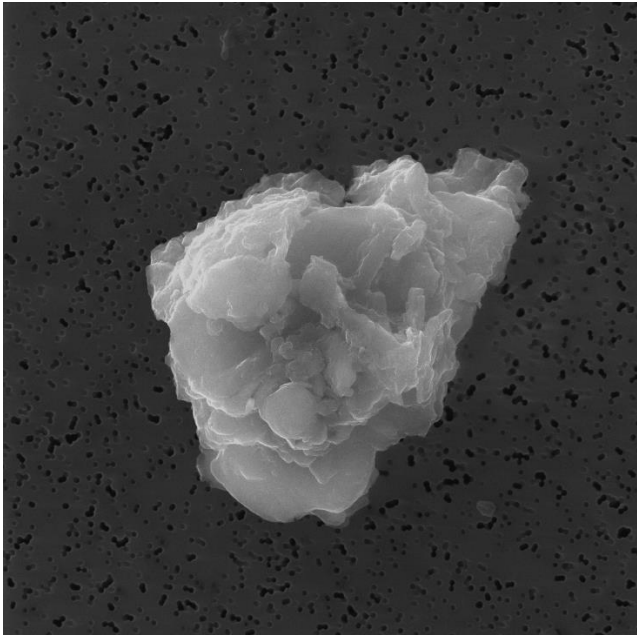


DT3.3 082015
August 2015
Image 03
Calcite and clay with minor amounts of halite and apatite?



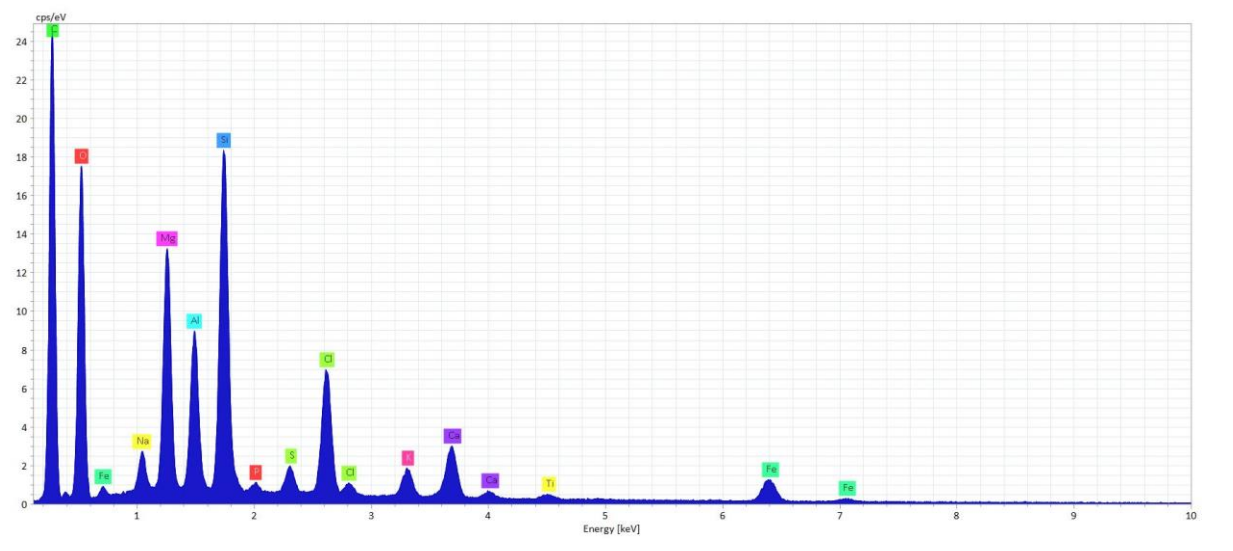
Supplement D

SEM based Secondary Electron Images



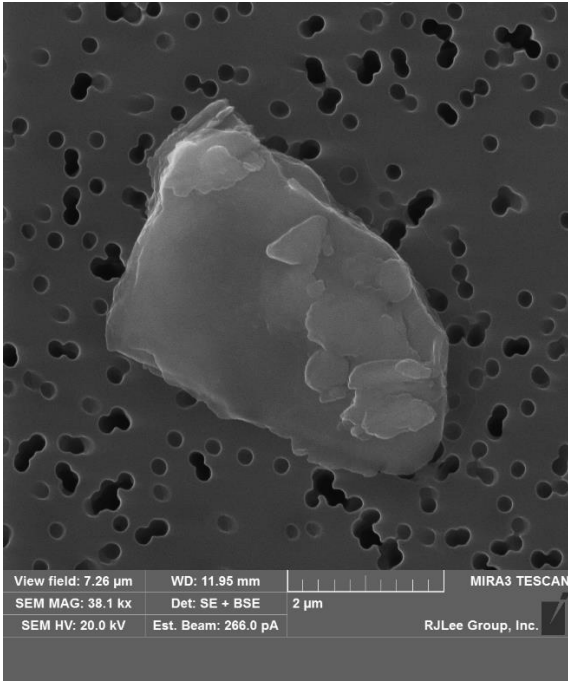
View field: 22.3 μm	WD: 11.95 mm	MIRA3 TESCAN
SEM MAG: 12.4 kx	Det: SE + BSE	5 μm
SEM HV: 20.0 kV	Est. Beam: 266.0 pA	RJLee Group, Inc.

DT3.3 092015
September 2015
Image 01
Aggregate particle of clay, bischofite, calcite, halite and gypsum?

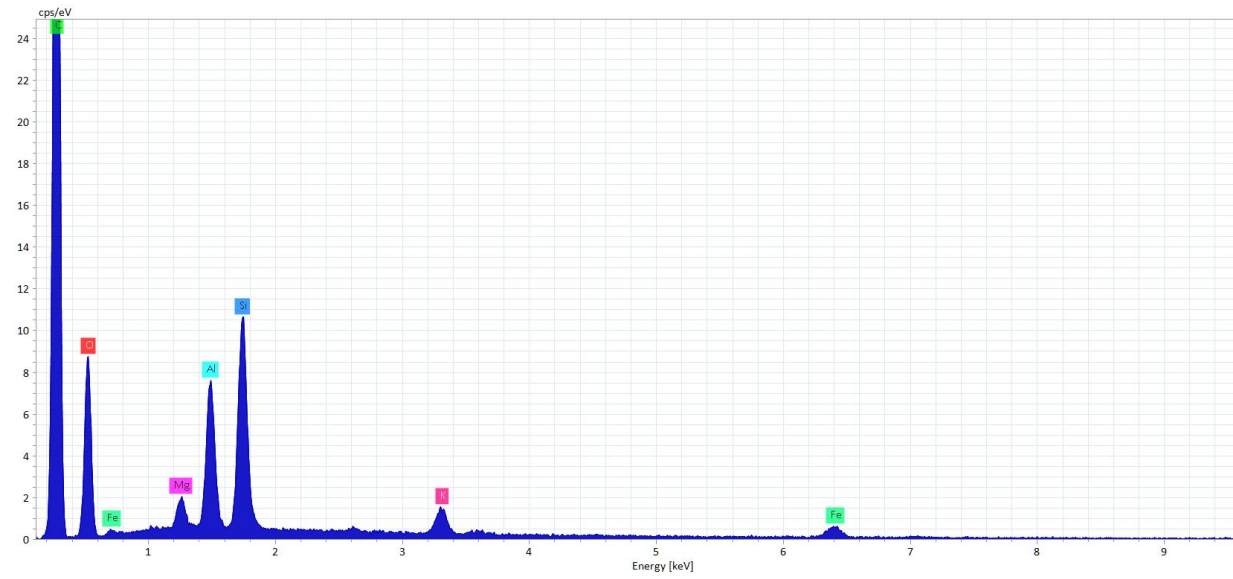


Supplement D

SEM based Secondary Electron Images

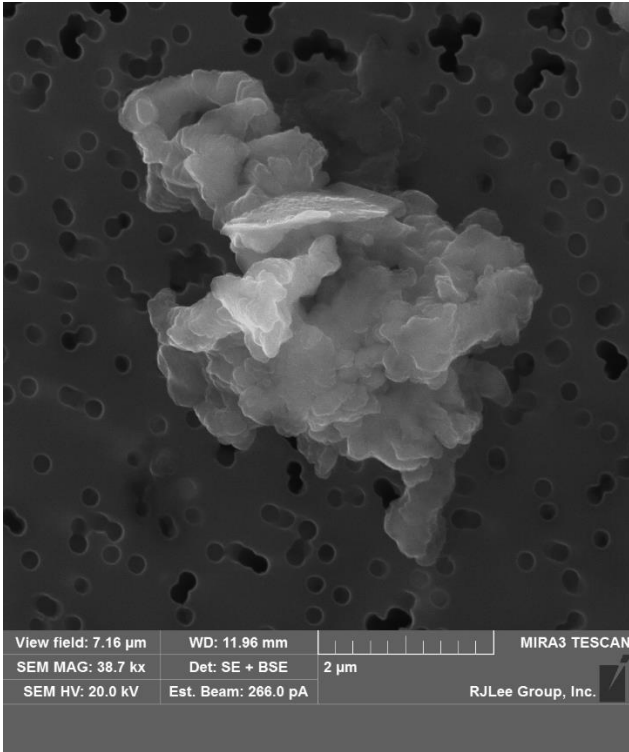


DT3.3 092015
September 2015
Image 02
Clay flake

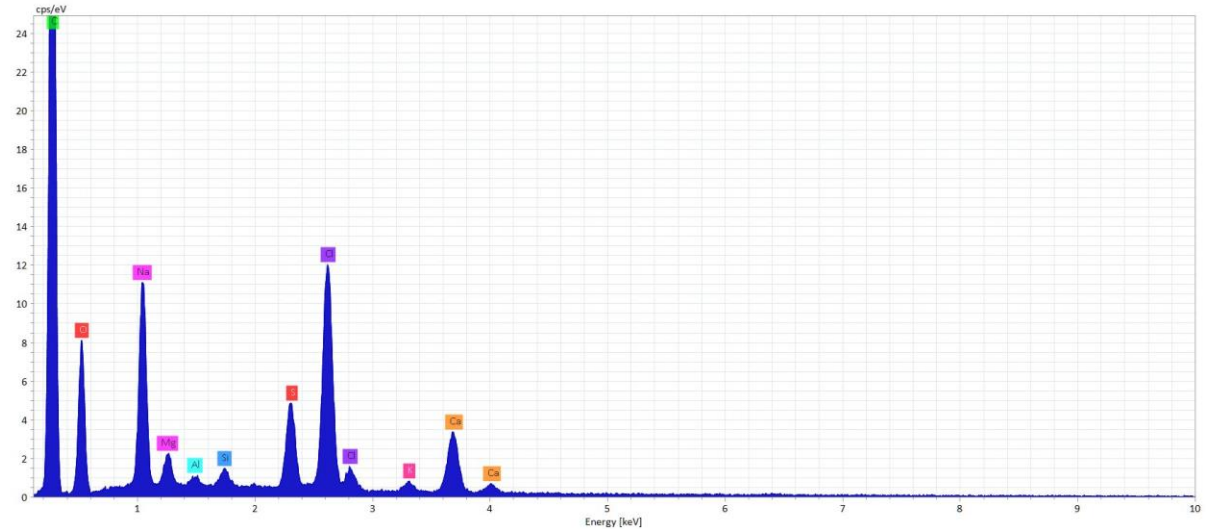


Supplement D

SEM based Secondary Electron Images

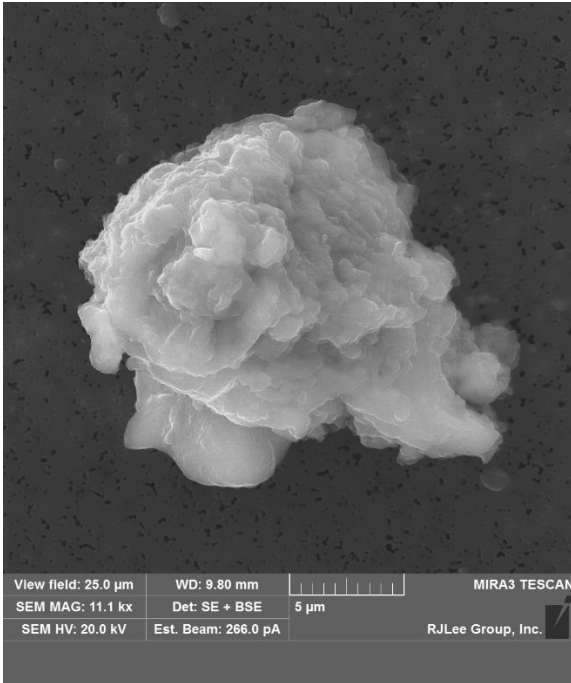


DT3.3 092015
September 2015
Image 03
Composite particle of halite, gypsum, calcite,
bischofite and clay?

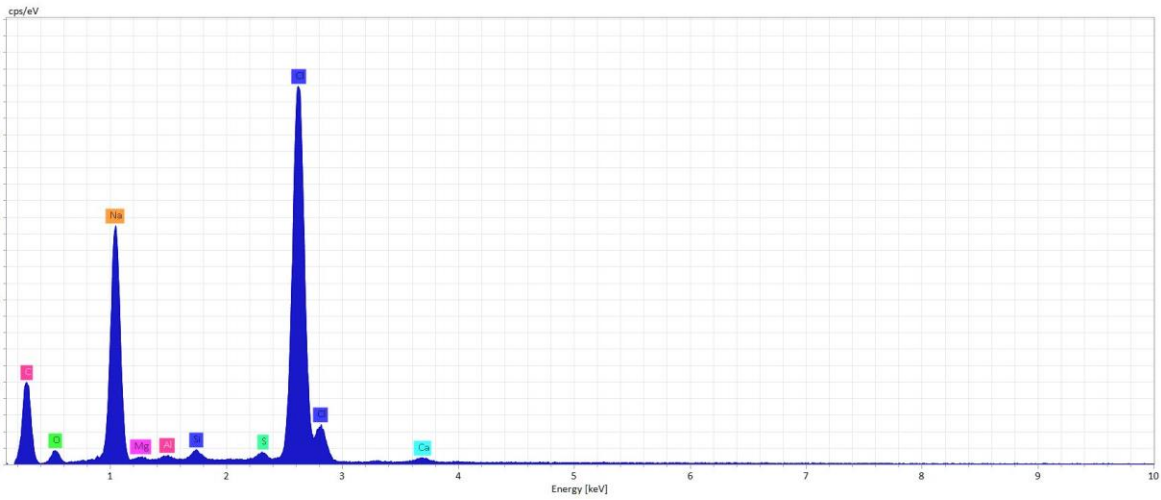


Supplement D

SEM based Secondary Electron Images

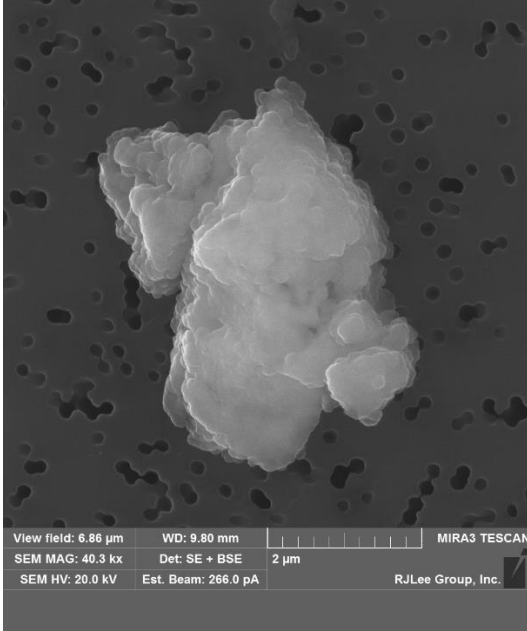


DT3.3 092015
September 2015
Image 04
Composite particle of largely halite with minor
amounts of clay and gypsum?

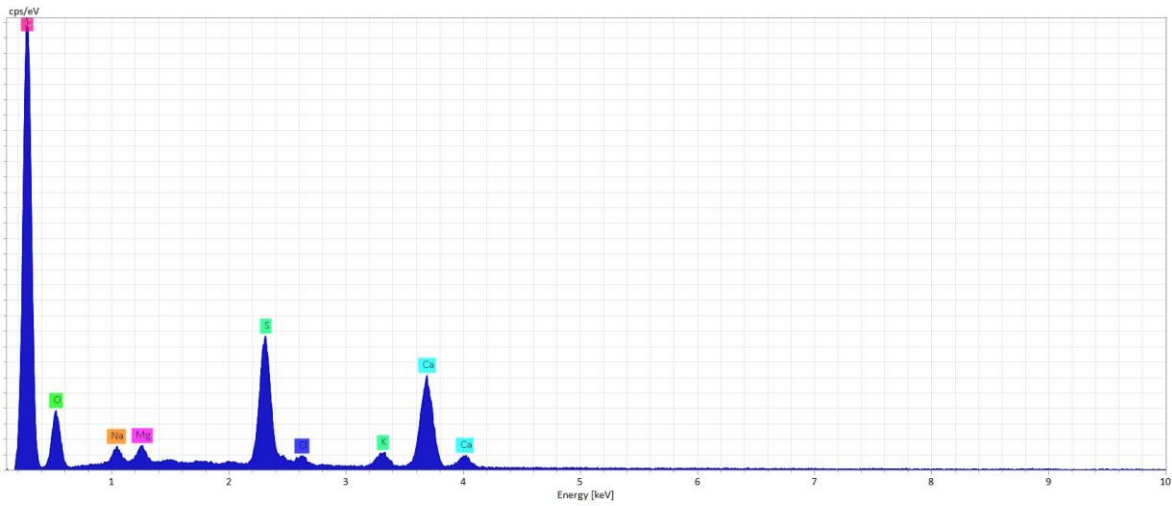


Supplement D

SEM based Secondary Electron Images

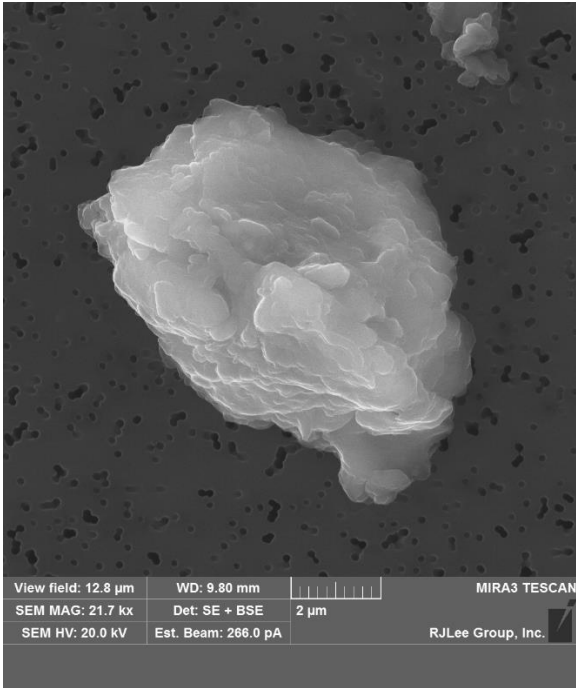


DT3.3 092015
September 2015
Image 05
Gypsum particle with minor amounts of halite
and bischofite?

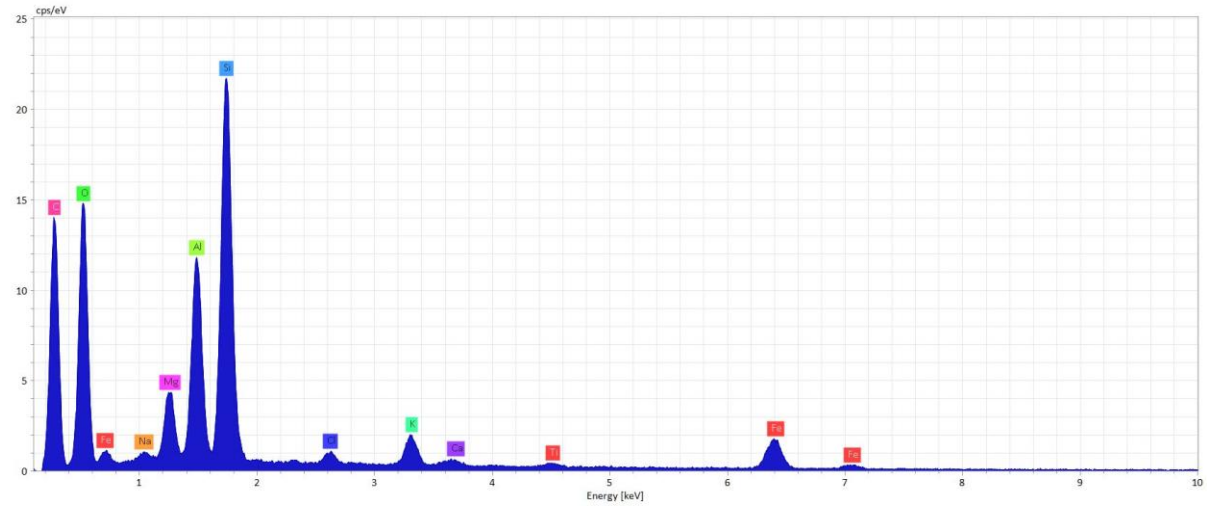


Supplement D

SEM based Secondary Electron Images

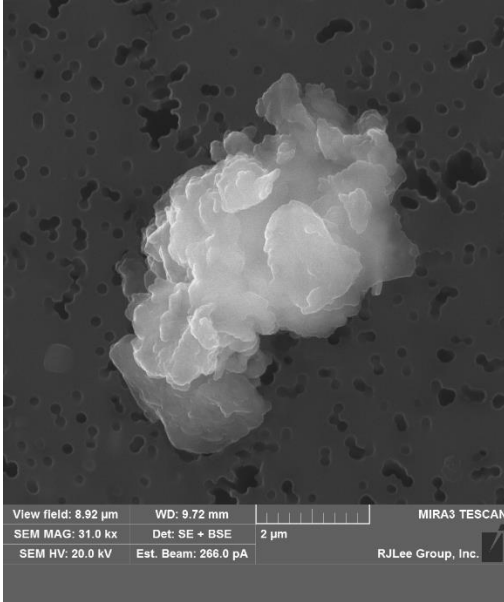


DT3.3 092015
September 2015
Image 06
Clay with minor amounts of halite and calcite?

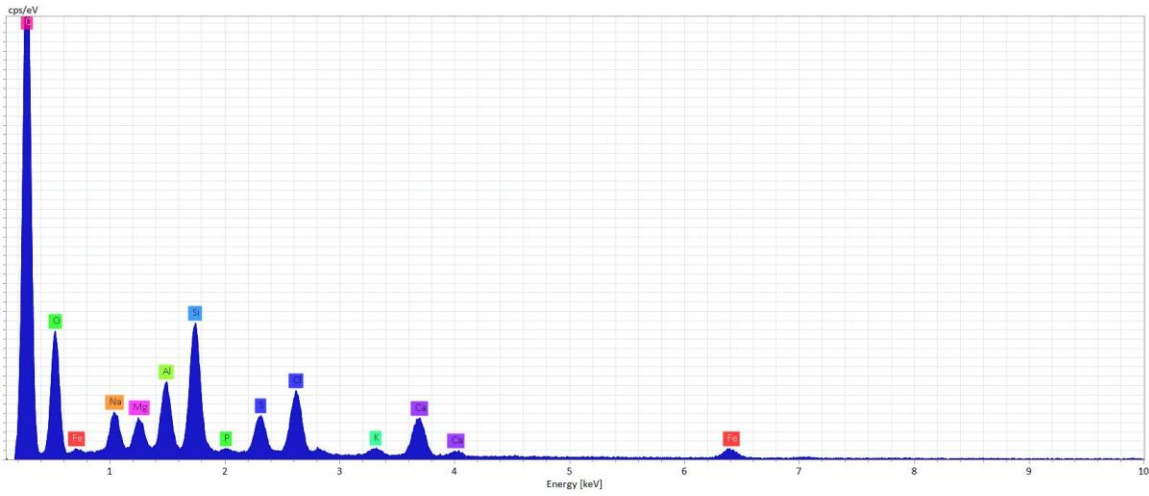


Supplement D

SEM based Secondary Electron Images

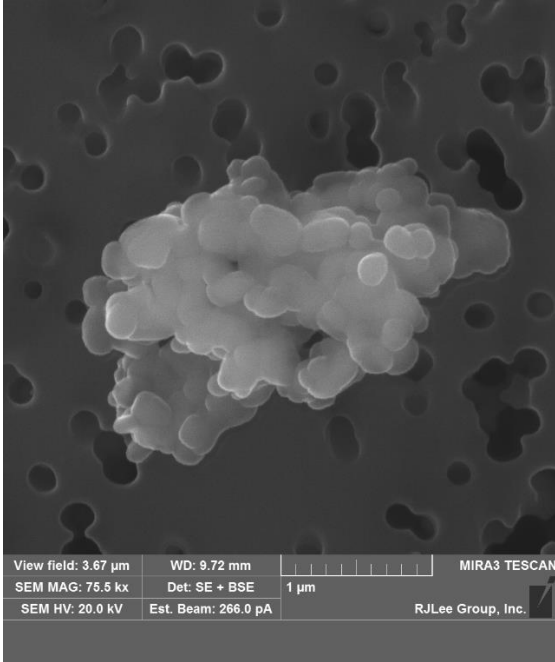


DT3.3 102015
October 2015
Image 01
Clay with minor amounts of halite and gypsum?

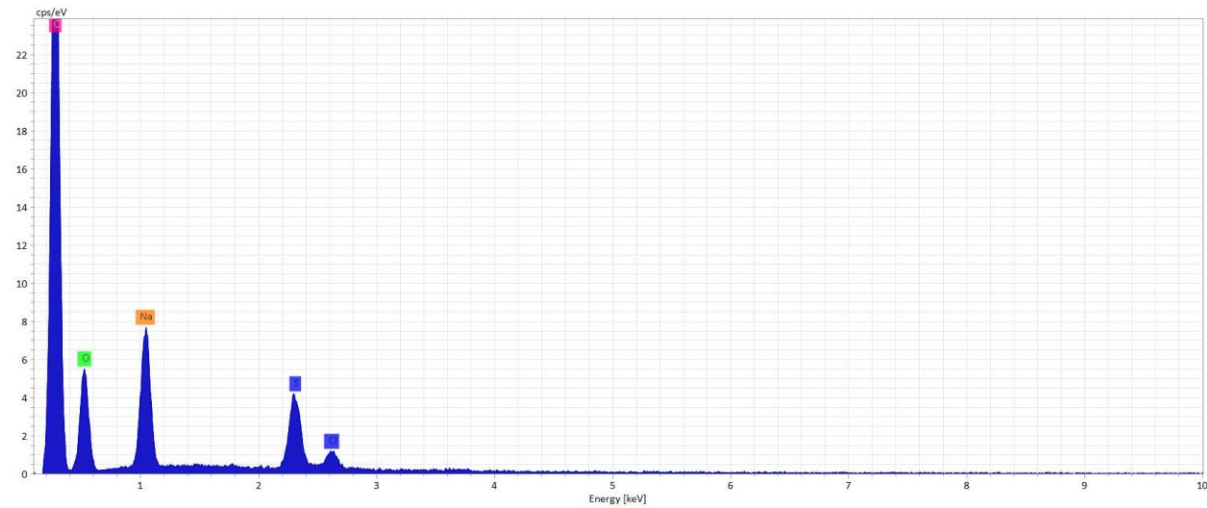


Supplement D

SEM based Secondary Electron Images

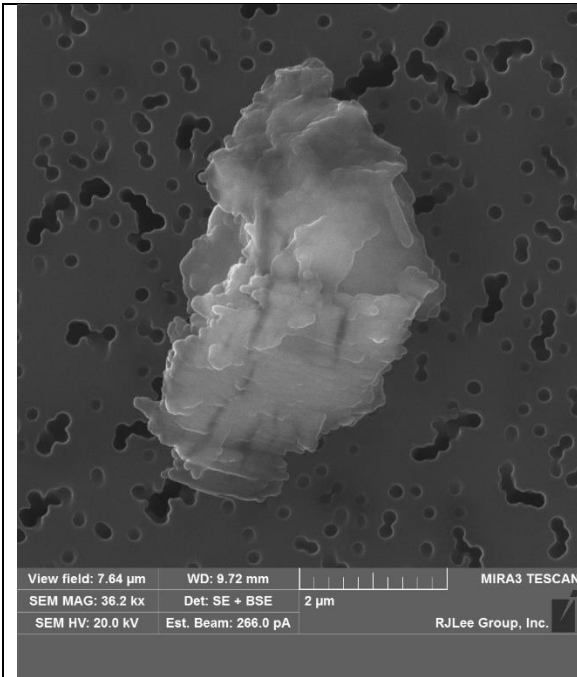


DT3.3 102015
October 2015
Image 02
Halite and sodium sulfate?

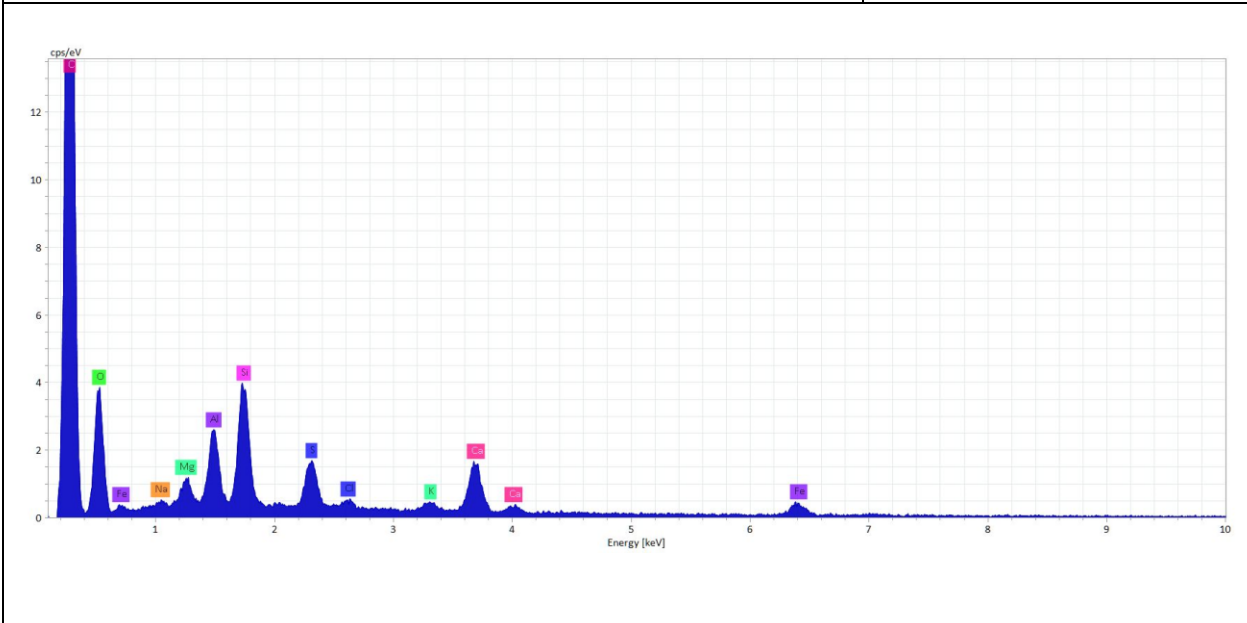


Supplement D

SEM based Secondary Electron Images

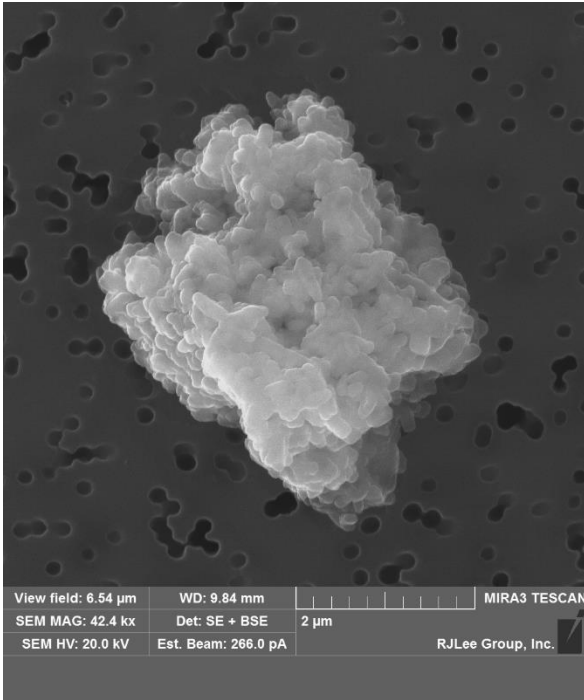


DT3.3 102015
October 2015
Image 03
Clay with minor amounts of
gypsum and halite?

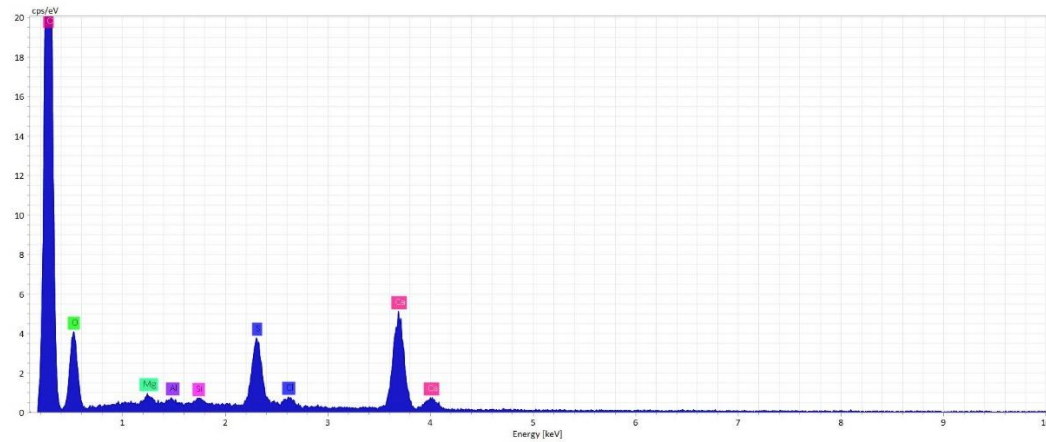


Supplement D

SEM based Secondary Electron Images

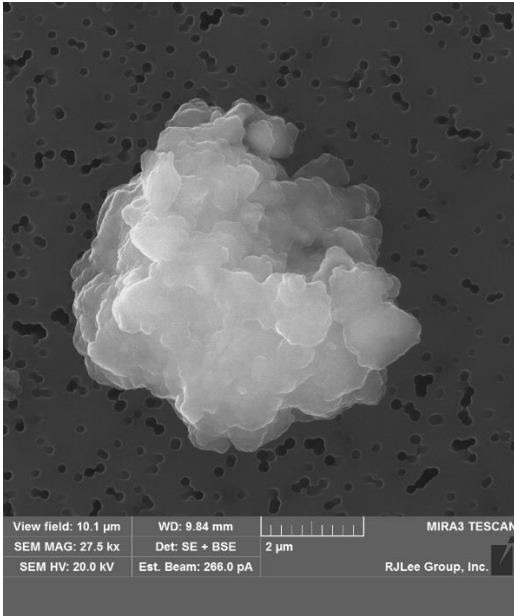


DT3.3 112015
November 2015
Image 01
Gypsum with minor amount of clay?

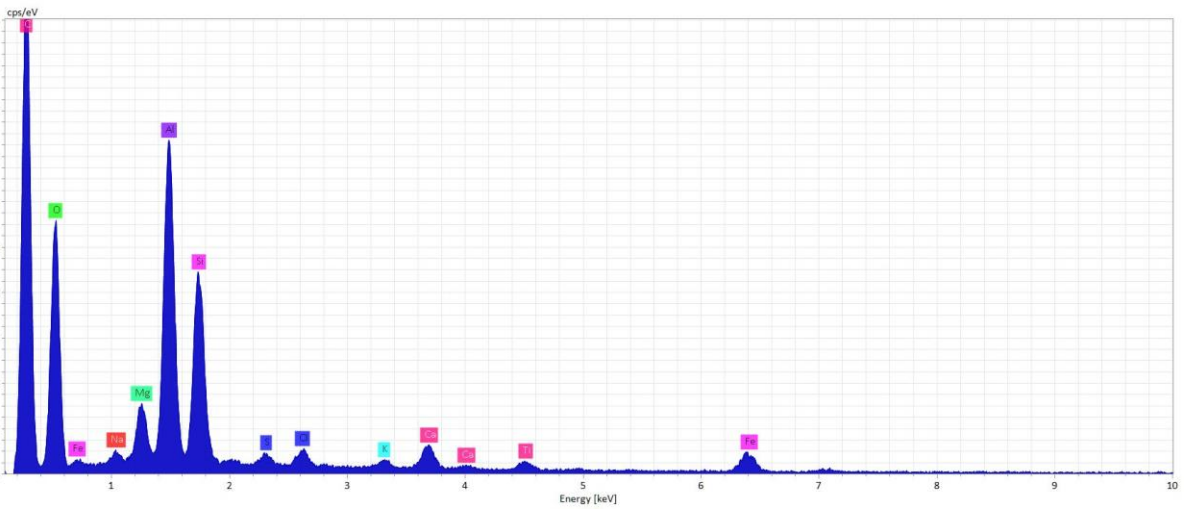


Supplement D

SEM based Secondary Electron Images

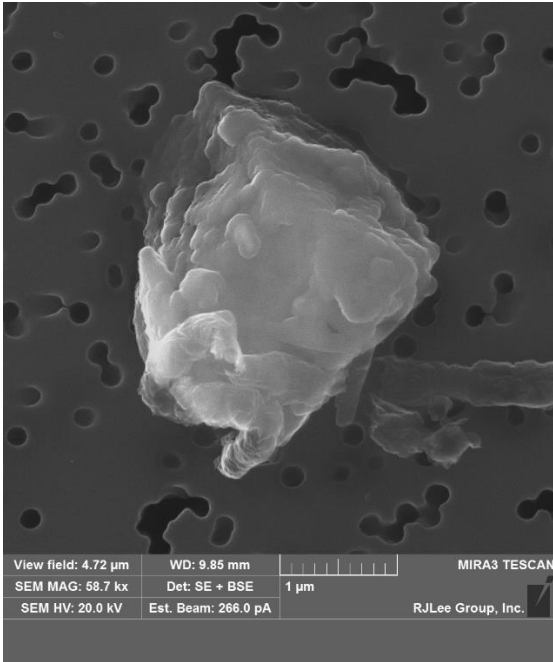


DT3.3 112015
November 2015
Image 02
Clay (kaolinite) with minor amounts of gypsum
and halite?

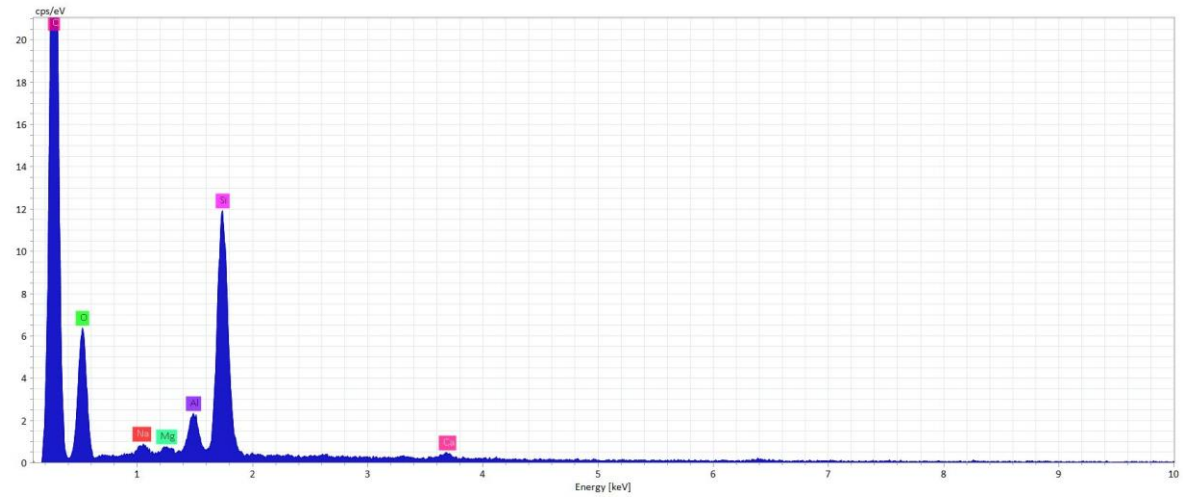


Supplement D

SEM based Secondary Electron Images

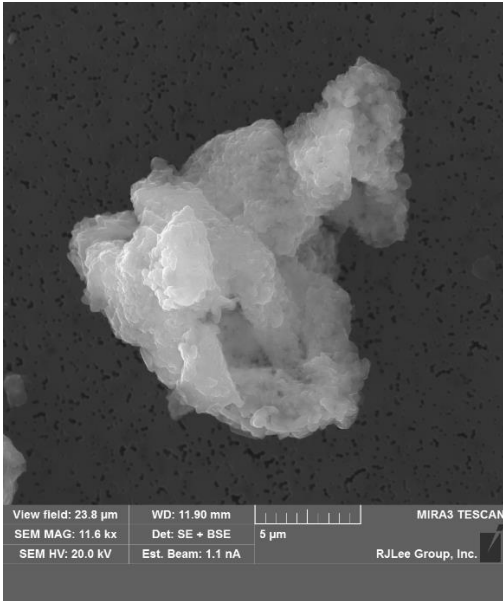


DT3.3 112015
November 2015
Image 03
Quartz with minor clay and halite?

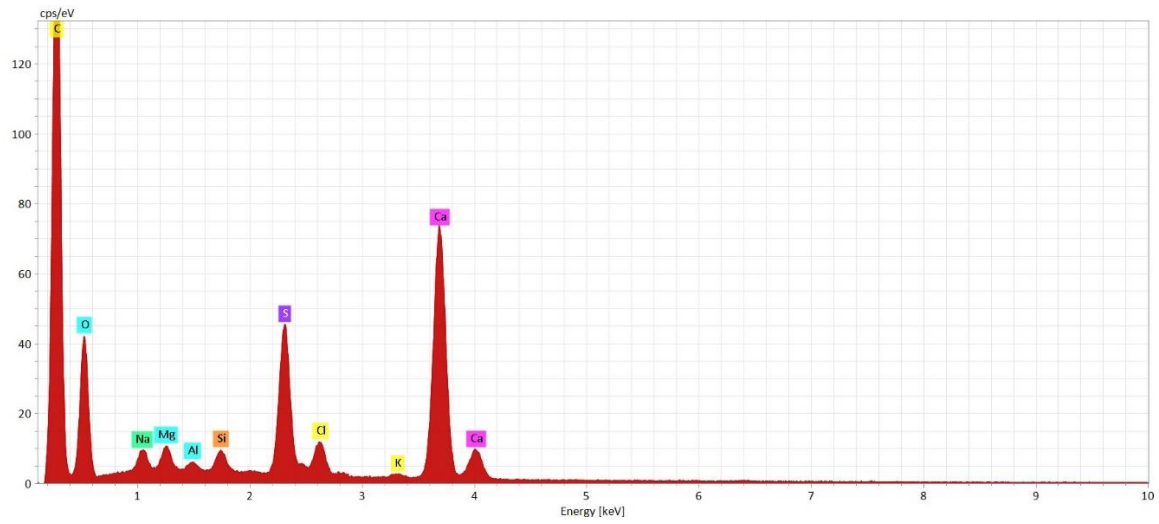


Supplement D

SEM based Secondary Electron Images

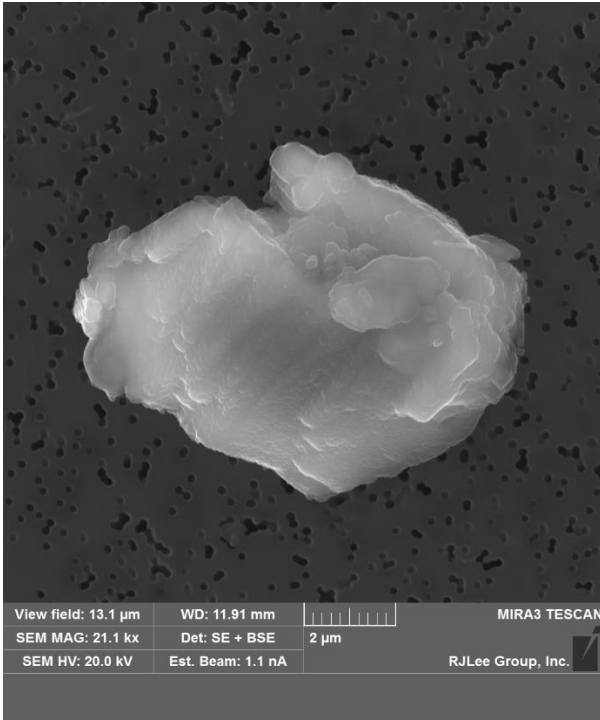


DT3.3 122015
December 2015
Image 01
Gypsum with minor halite and clay?

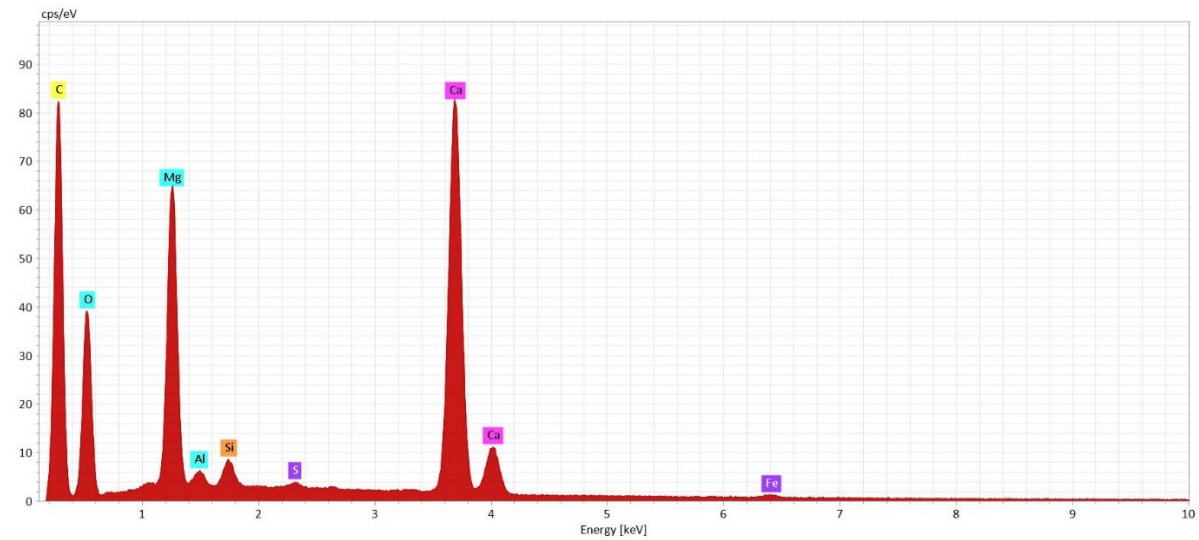


Supplement D

SEM based Secondary Electron Images

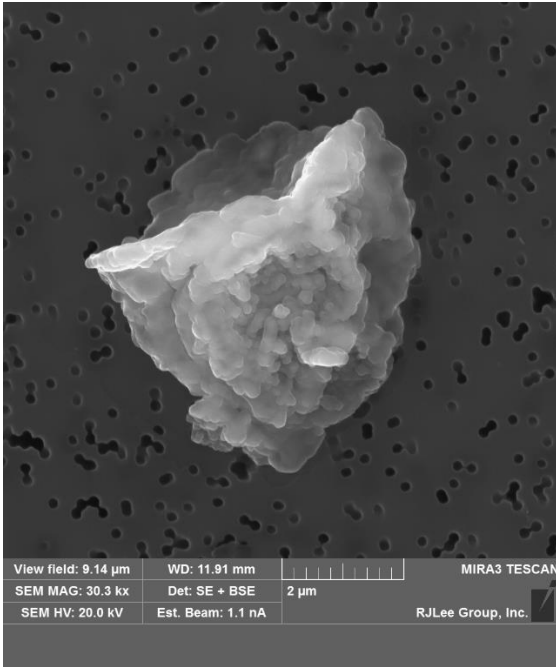


DT3.3 122015
December 2015
Image 02
Dolomite with minor amounts of clay and
gypsum?



Supplement D

SEM based Secondary Electron Images



DT3.3 122015
December 2015
Image 03
Calcite and gypsum with minor clay and halite?

