Evidence of Vitrified Stonework in the Inca Vestiges of Peru

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INTRODUCTION

Vitrified stones are simply stones that have been melted to a point where they form a glass or glaze. There is much debate in archaeological circles over the ancient examples under study for two reasons. Firstly, few cases are known to have been tested and even if they have, there are many questions over how they were made.

Glassy rocks form naturally under conditions of high temperature and pressures found in and around volcanoes. Glass or glazes are traditionally created using a furnace. Furnace or kiln examples are found on everyday objects such as glassware and ceramics. The ceramics glazes are created by pasting certain finely crushed stones, sometimes with tinctures, onto fired pots and plates. The whole is then fired to temperatures usually in excess of 1000 degrees centigrade.

The difficulty with many of the curious ancient vitrified examples is that they are found on objects so large that they cannot be placed in a furnace. The vitrification process itself is quite a mystery. A team of chemists on Arthur C. Clarke's Mysterious World subjected rock samples from 11 forts to rigorous chemical analysis. They concluded that the temperatures needed to produce the vitrification were up to 1,100°C. Simply burning the walls with wood interlaced with stone could not achieve such temperatures. Recent experiments along these lines have had virtually no success at all.

There are several confirmed cases of unusual vitrified remnants from across the globe. In Europe, there are several forts and buildings with vitrified ramparts. The crude stone enclosure walls seem to have been subjected to the action of heat. No mortar has been found in any of these structures. Despite this, the rocks seem to be fused together.

This fusion is uneven throughout the various forts and even in a single wall. Some stones are only partially melted and calcined. Whilst in others their adjoining edges are fused firmly together. In many instances, pieces of rock are enveloped in a glassy enamel-like coating, which binds them into a whole. At times, the entire length of the wall presents one solid mass of vitreous substance.

It is not clear why or how the walls were vitrified. Some have argued that it was done to strengthen the wall, but the heating weakens the structure. Battle damage, as some have proposed, is unlikely to be the cause. The walls would need carefully maintained fires to ensure vitrification.

There are about fifty examples that have been discovered in Scotland. It was thought that these forts were peculiar to Scotland. However, they are also found in County Londonderry and County Cavan, in Ireland. On mainland Europe, they have been identified in Upper Lusatia, Bohemia, Silesia, Saxony and Thuringia. A further example can be found in the Ucker Lake, in Brandenburg, where the walls are formed of burnt and smelted bricks. There are also displays in several places in France, such as Châteauvieux,

Péran, La Courbe, Sainte Suzanne, Puy de Gaudy and Thauron

There are some forts that have been placed on practically infusible rock. The quartz conglomerates of the Old Red Sandstone at Craig Phadraic and on the limestone of Dun Mac Uisneachain are good cases. Here pieces of fusible rocks were selected and carried to the top from a considerable distance. This demonstrates that the act of vitrification was deliberate.

There are many more examples from Malta, Egypt, Iraq, Sudan, South East Asia and others that are speculated to fall into the grouping. However, these have not all been subjected to scientific testing like the European cases. They simply appear to be glazed finishes on equally large objects or on walls that are impossible to fire conventionally. In many cases it looks as if there has been the deliberate action of a great heat.

There has been much discussion about the Inca vestiges in the Peruvian Andes. It mostly revolves around whether the stones are vitrified or not. In these cases, vitrification appears to be present on different kind of stones, and seems to have been caused by deliberate action. This paper will now concentrate on these Peruvian cases where there are indications of heat treatment.

THE PERUVIAN CASE STUDY

The vitrified examples under study for this paper come from famous Peruvian sites, considered to belong to the Incas, in South America. To the author's knowledge, there have been no scientific tests made on these stones. This has left the debate open to claims of unusual polishing techniques, natural degradation, lava flows and many other odd explanations. Hopefully, the analysis below will eliminate some of these ideas.

The vitrified stones of Peru were first brought to popular attention by Erich von Daniken in the 1970s. He saw the vitrification at Sacsayhuaman and noted it in his book Chariots of the Gods. Peruvian Alfredo Gamarra had identified this vitrification earlier. The identification and cataloging of these intriguing stones has been carried on by Alfredo's son Jesus Gamara, and Jan Peter de Jong.

Some examples of what are believed to be vitrified stones are shown below:

Walls of Loreto Street, centre of Cusco, especially on the borders and some other spots:

Loreto Street at night:

Also on the face of the stones:

Templo de la Luna (or Amaru Machay), belonging to the Sacsayhuaman archaeological parquet. A snake-form made on the wall of this cave, also on other parts of the walls and an altar (see below):

Snake form made in the wall:

Altar with vitrified surface:

In Sacsayhuaman, there are many indications of the use of heat. Strange marks on the stones like the one below can be found; shiny, completely smooth and with another color to the rest of the rock:

Straight, smooth line, discolored:

The same rock with melted look & reflection:

Vitrification appears on different kinds of stones and structures. It is found on the perfectly fitted walls with irregular blocks. It is also observed on walls made with regular oblong blocks. It has been spotted on mountainsides, caves and rocks in situ. The location arrangements vary as well. Some sites are surrounded or overbuilt by walls whilst others have single exposed isolated stones. There seems to have been some very adaptable ancient technology at work. A list of vestiges where stonework seems to have been treated with this technology include; In Cusco, the walls of Koricancha, Loreto Street, Sacsayhuaman, Kenko, Tetecaca, Templo de la Luna (or Amaru Machay), Zona X, Tambo Machay, Puca Pucara, Pisac, Ollantaytambo, Chinchero, Machu Picchu, Raqchi and in Bolivia in Tiahuanaco.

Archaeologists assume that the perfect fitting stones are the most developed style of the Incas. Regardless, there is no explanation of the shiny surfaces that can be observed. These often appear on the borders where the stones join perfectly. There has been nothing other than simple geological analysis of these stones to determine what the phenomenon is. No chemical analysis is known to have been executed. It is normally assumed that these parts were simply polished by the Incas.

During many visits to the vestiges mentioned, Jesus Gamarra and Jan Peter de Jong have examined these stones with highly reflective surfaces. They have captured many of them on video. Through personal observations and analysis of the video material, they have concluded that something other than polishing must have occurred.

The material convinces in several ways. Many cases display some or all of the following qualities mentioned below. The vitrified spots show discoloration and smoothness around the particular areas. They clearly look like the stone has been melted just in those spots. A simple flashlight test was developed, which helps to identify the layers of glaze or glass. Filming was carried out at night with a flashlight beam passing through the glaze.

This shows the reflection and diffraction of the light as it passes through the surface. Sacsayhuaman, Kenko and Loreto Street were all filmed at night using a flashlight or the nocturnal illumination to capture the effect.

Identifying Vitrified Stones.

The following traits help to identify vitrified stones:

- The melted effect is obvious
- Reflection is high
- The layer refracts, diffracts and diffuses light
- A separate vitrified layer is present on the surface
- Damaged layers show a ´film´ on the stone
- The glazed layer is independent of rock type
- The surface is smooth to the touch even if the surface is irregular
- There is often associated heat discoloration surrounding the glaze

The diffraction effect can be seen in the video of 'the Inca Throne' at Sacsayhuaman. The rainbow effect is clearly captured by the camera. This is directly linked to the light passing through the glass layer and splitting into its constituent parts. After noticing this effect, it was also detected on videos of other vitrified stones. This can be viewed on this short video: http://www.youtube.com/watch?v=ae_8ri2fiwI **,** and on the DVD that will be available shortly.

The DVD "The Cosmogony of the 3 Worlds" shows an overview of this phenomenon in the chapter on Vitrified Stones.
This is available on youtube http://www.youtube.com/watch?v=x81-5SWVtUQ

VITRIFIED STONE SAMPLE ANALYSIS

In order to get a clear idea of what the make up of these intriguing layers of stone are, a sample has been tested. A small sample from the Peruvian site called Tetecaca has been collected for further analysis. This smooth layer has been analyzed by the University of Utrecht, Holland.

The sample is from a rock outcrop above Cuzco. Inside a cave there is an altar formed from rectangular shapes made of the rock. Several lines in the rock have a shiny surface, as if they were branded into the rock. They are on right lines on the wall of the cave. The walls are cut out with curved and rectangular forms in them. These are man made structures, which rules out natural phenomena.

Some pictures from inside of the cave, here walls and an altar structure:

Long, straight and reflecting lines:

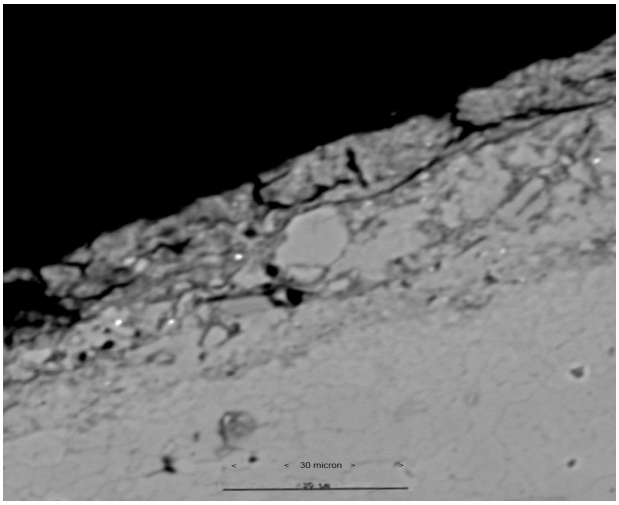
Below is a picture of the spot where the sample was found. The white line indicates where the thin section was made:

The smooth layer on the picture is about 2 cm wide and 1.3 cm deep. The sample was carefully cut into two parts and a thin section was taken for analysis in the Microprobe, jxa 8600 Pioneer. Several points were measured on the inside of the sample and on the smooth surface.

RESULTS

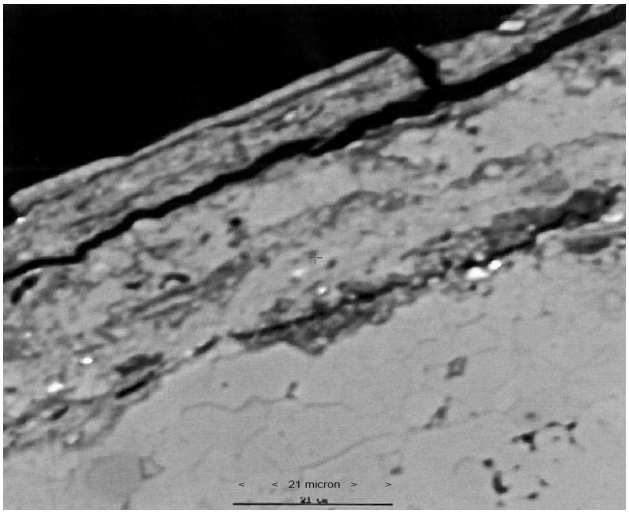
The sample as photographed by the microscope. It shows two distinct regions, the surface layer and the body stone. There is a less distinct intermediate area between the two that seems to transition from stone body to surface layer. Samples from all three regions were subjected to detailed analysis.

Photo 1:



Line at bottom of the picture is 21 micrometer

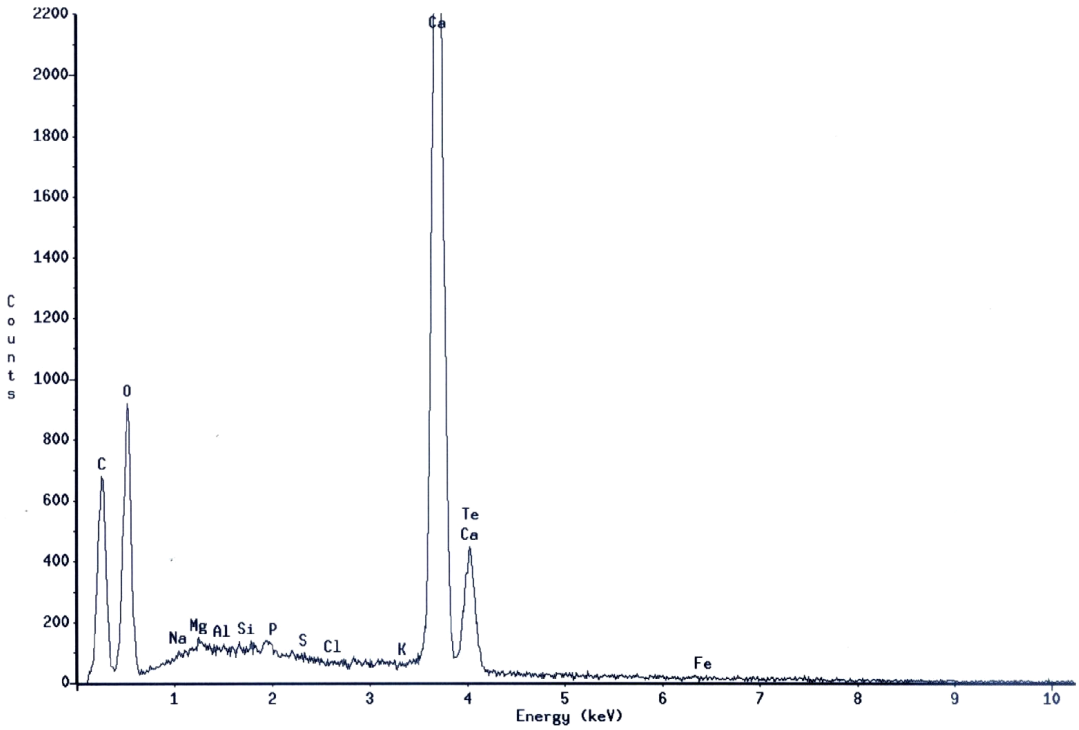
Photo 2:



Line at bottom of the picture is 30 micrometer

Spectral Analysis of the three distinct regions:

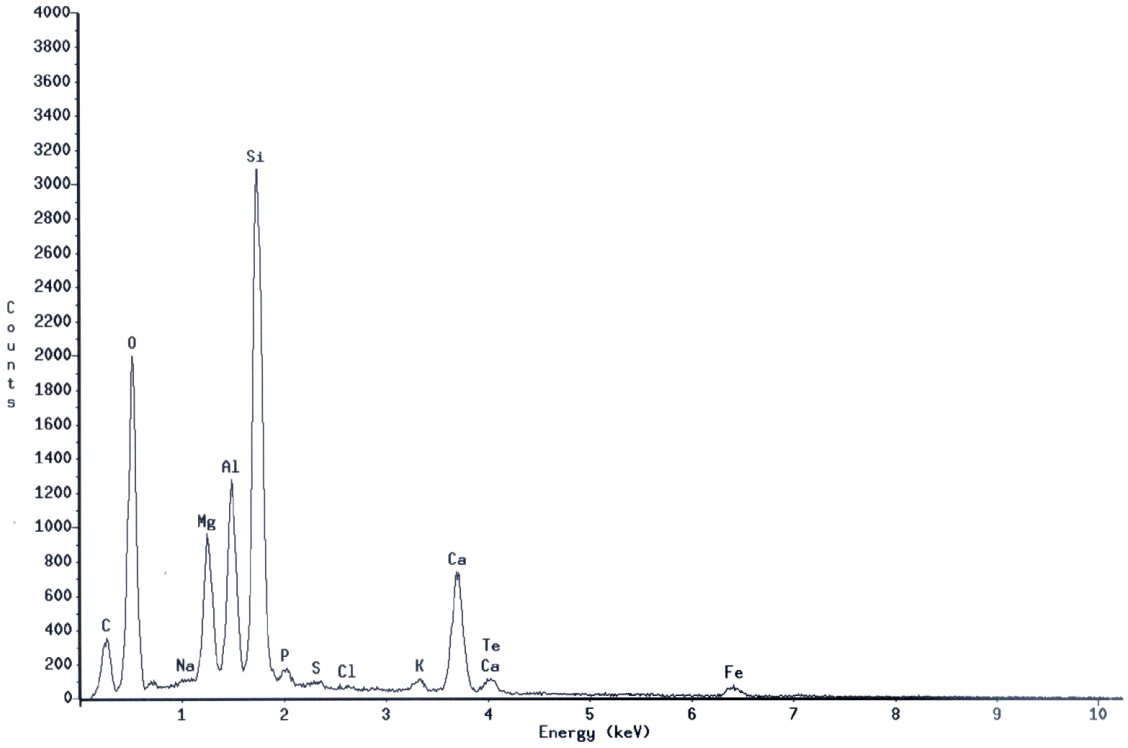
Graph 1
The Main Body of the Stone:



Column	: JXA_8600_Pioneer		
Take-off angle	: 40	Accelerating voltage	: 15
Acquisition type	: eds	Magnification	: 170
Creation time	: 2010/03/30 11:33	Charge	: 400
Livetime	: 20	Beam current	: 20
Deadtime	: 1.983	Beam spot size	: 0
Channels	: 1024	Beam location	: 0,0
Channel width	: 10	Working distance	: 11
Detector type	: Silicon/Lithium	Stage X	: 17.662
Window type	: norvar	Stage Y	: 56.544
Window thickness	: 0.3	Stage Z	: 11.433
Coating material	: Al	Stage tilt	: 0
Coating thickness	: 0.04	Stage rotation	: 0
Contact material	: Au	Contamination material	: none
Contact thickness	: 0.02	Contamination thickness	: 0
Crystal thickness	: 3		

File name : /usr/home/voyager/spectra/JPdeJongAndesKern.eds

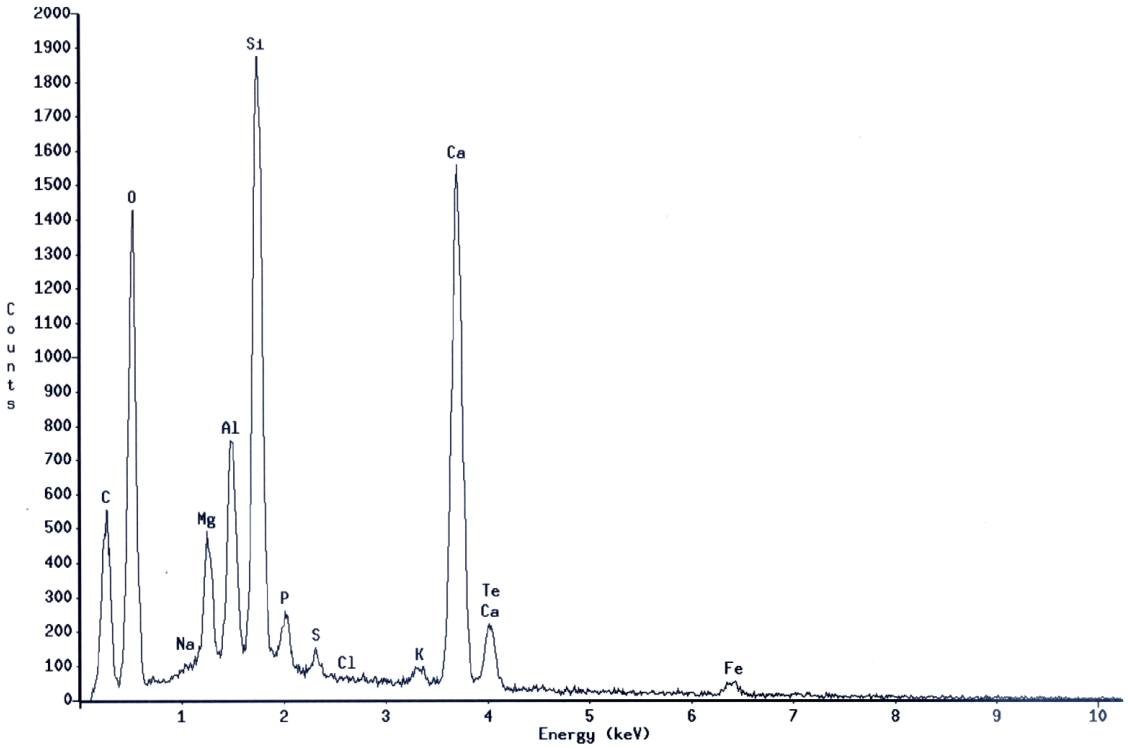
Graph 2
The Vitrified Surface of the Stone



Column	: JXA_8600,Pioneer		
Take-off angle	: 40	Accelerating voltage	: 15
Acquisition type	: eds	Magnification	: 5000
Creation time	: 2010/03/30 11:58	Charge	: 400
Livetime	: 20	Beam current	: 20
Deadtime	: 2.384	Beam spot size	: 0
Channels	: 1024	Beam location	: 0,0
Channel width	: 10	Working distance	: 11
Detector type	: Silicon/Lithium	Stage X	: 15.995
Window type	: norvar	Stage Y	: 48.376
Window thickness	: 0.3	Stage Z	: 11.434
Coating material	: Al	Stage tilt	: 0
Coating thickness	: 0.04	Stage rotation	: 0
Contact material	: Au	Contamination material	: none
Contact thickness	: 0.02	Contamination thickness	: 0
Crystal thickness	: 3		

File name :

Graph 3:
The Intermediate Region
Between the
Surface and Body of the Stone



Column	: JXA_8600,Pioneer		
Take-off angle	: 40	Accelerating voltage	: 15
Acquisition type	: eds	Magnification	: 2300
Creation time	: 2010/03/30 11:50	Charge	: 400
Livetime	: 20	Beam current	: 20
Deadtime	: 2.157	Beam spot size	: 0
Channels	: 1024	Beam location	: 0,0
Channel width	: 10	Working distance	: 11
Detector type	: Silicon/Lithium	Stage X	: 16.086
Window type	: norvar	Stage Y	: 48.424
Window thickness	: 0.3	Stage Z	: 11.434
Coating material	: Al	Stage tilt	: 0
Coating thickness	: 0.04	Stage rotation	: 0
Contact material	: Au	Contamination material	: none
Contact thickness	: 0.02	Contamination thickness	: 0
Crystal thickness	: 3		

File name : /usr/home/voyager/spectra/JPdeJongAndesrand.eds

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SPECTRAL ANALYSIS

Graph 1: The Main Body of the Stone, clearly shows the spectral composition for limestone. High levels of calcium, carbon, oxygen and minor trace elements are the constituents of limestone.
This is not unusual since the University of Cusco recognize the Sacsayahuaman archaeological park as being a karst landscape. This cave is nearby the Sacsayhuaman vestige. Many cave systems are made in limestone bedrock and the sample was from this sort of cave. However, this cave was worked on by people in the past as is clear by the photos above.

Graph 2: The Vitrified Surface of the Stone. The surface layer shows a very different spectrum of elements to the limestone body. The glaring difference is that Silicon is the predominant component with much higher concentrations. The trace elements of Aluminum and Magnesium are also significantly higher than the body of the stone. Oxygen is also present in double the quantities found in the body. The quantities of Calcium and Carbon are much lower than the body sample.
The Silicon, Aluminium and Magnesium seem to indicate that a material was added to the surface of the stone. The oxygen may have been part of this matter or it may have been introduced as part of oxidation during an aerobic heating process. This could have been during the formation of silicate, SiO_2.

Graph 3: The Intermediate Region Between the Surface and Body of the Stone. This graph shows a gradation of composition between the other two. This region was immediately below the surface layer, only 5 micrometer beneath.

Element	Body of Stone	Intermediate	Surface Layer
Calcium	2200	1500	800
Carbon	700	550	300
Oxygen	900	1400	2000
Silicon	100	1900	3000
Aluminum	100	750	1300
Magnesium	100	500	1000

This is a surprising result, it implies one of three things. Either the surface layer was somehow ground and mixed with the body of the stone. The body limestone somehow merged/melted with the surface layer. Lastly and most unlikely, the limestone constituents could have been a part of the added surface layer. If this last one were true the second and third spectra would have been more similar.

CONCLUSIONS

The body stone is limestone, but the surface is more complicated. Its spectrum shows some similarity to Wollastonite, which forms when impure limestone is subjected to high temperatures and pressures. However, the impurities that are seen in the surface are not present in similar amounts in the stone body. This indicates that the compounds in the surface layer were most likely added. Other stone types may be comparable, but they cannot have formed naturally in the layer on the man made surface. It appears they were applied and treated with heat. This option does have some merits, but it is moving towards the arcane world of the ceramist.

If an antique ceramic sample is compared to the spectra of the glaze above there is little to separate the two. In the Paper X-Ray Techniques Applied to Surface Paintings of Ceramic Pottery Pieces From Aguada Culture (Catamarca, Argentina) there are several comparable results. The samples are from pottery pieces from Argentina so an exact match is unlikely. These researchers tested a variety of different colored samples from Argentine pottery shards, which had residual gold leaf on the surface. The spectra are surprisingly similar if the gold leaf is ignored along with the Manganese (Mn) and Iron (Fe). The latter two elements have oxides that are common colorants in ceramic pastes. This is the source of the various colors in their research paper. The key constituents Silicon, Aluminum, Magnesium, Carbon and Oxygen are present in the same ratios.

Whilst the spectra do not show explicitly that the surface is vitrified, the composition is that of a glaze. It has a different makeup to the limestone body. This means it is very likely that the glaze was made from a ceramic paste applied to the limestone surface. This is clear from the comparison with the ancient glazed ceramic pottery shards.

The microscope photos above of the surface do not show the amorphous state of the layer. This can be shown explicitly by electron microscopic analysis. Further analysis needs to be carried out to confirm the state of the layer. The different chemical composition makes it very unlikely that these surfaces were created by polishing. The layer has the composition, sheen, hardness and glassy texture of a glaze.

The results strongly indicate that heat was used to produce the surface, which raises several questions. Even if a layer of a ceramic paste was applied, how was the whole heated to the requisite temperatures without cracking the limestone? It tends to shatter at these sorts of heats.

How was the heat produced to treat these structures? Whilst this sample is from a cave, there are similar structures that are outside with the same kind of glaze. The same conclusion cannot necessarily be applied to these other cases.

Chemical analysis is needed, but the similarities with the investigated sample and other photographed cases, are clear. It is likely that these other cases are also vitrified. The

amount of heat needed to fire the huge stones on which these glazes are found is enormous. In furnaces, the whole body has to be raised to the temperature of the surface glaze. This is done slowly over the course of many hours. How the heat would have been produced is unknown.

DISCUSSION

The stones pictured above provoke much debate. Explanations on how they were produced vary from the use of advanced machines, simple metal or stone tools, molded stonework, concentrated sunlight and fire methods. Whilst the analysis above says little about the way the shapes were made, it does eliminate some ideas on the means of producing these exquisite finishes.

The finish on the stone sample was not the thickest, shiniest or the glassiest of the examples. However, its composition and morphology are the same as a ceramic glaze. This means that heat was somehow applied to the stone. How the heat was applied is not clear. What is clear is that an unknown technology has been used. To create ceramics on this scale, the heat production must have been greater than the normal ceramic methods.

The most referenced work on the stonework of Peru was produced by Protzen. His work deals primarily with the carving of the stones with primitive tools. However, Protzen has looked at these effects and has suggested it could be achieved with polishing. To date, only Andesite has been attempted with very limited success. After the analysis of the surface layer above, it is clear that polishing alone will not produce the requisite heat needed to produce a ceramic glaze. This eliminates polishing as a means of creation. The scale and form of the phenomena also precludes carving and polishing. It would take truly incredible amounts of time to produce a single vestige, let alone the thousands that dot the landscape.

Peruvian Alfredo Gamarra has identified vitrification on many stones and has argued that the ancients had a technology to treat stone with heat and that the stone was soft at the moment of construction. The comparison at the spectrum level with clay and ceramic pastes is interesting. Ceramic pastes and clay are soft prior to being treated with heat. Conventional geological understanding is not compatible with this idea. However, the impression from the vitrified stonework is that the stone was once soft. In many of the stones, there are places where it looks as if objects or molds were pressed into the stone. The perfect fitting stones in the walls of Cusco and the other Inca vestiges could have been obtained more easily this way.

If the stones were fired in a kiln like bricks, the glaze could be a result of the extremely high temperatures. It is not uncommon for the bricks in ancient kilns to get so hot they melt. This usually occurs near the top of the chamber where the heat rises. The knowledge of ceramics in ancient Peru suggests this is a distinct possibility. This prospect however, only arises with the stones that can be placed in a kiln or stonework that is part

of a kiln.

The examples laid onto the sides of huge natural rocks cannot have been produced by standard fire techniques. The European studies of vitrified forts and experimental work show that it is not possible to create the consistent heat required for the smooth finishes. Compared to the European examples there must have been a much more controlled process, since the layers in Peru are even over large parts of the stone surfaces. The scale of giant perfect fitting walls and some vitrified mountain walls makes the technology question even more complicated than in Europe.

Another option is the use of sun dishes and concentrated sunlight by the ancients. This is briefly discussed by Prof. Watkins in his 1990 paper on fine Inca stonework. He did consider these stones to be vitrified, "The rock surfaces on Inca stones are similar to those that have been thermally disaggregated. Indeed, some of the slick surfaces on the Inca building stones are glazed, so it becomes apparent that the Incas must have used thermal disaggregation."

In this seminal paper, his chief concern was the methods of cutting the stone. Since he was proposing intense heat to cut the stones, it was not a large step to consider the stones melted. His conclusions have been much maligned since there had been no analyses performed.

The analysis above does point in this direction, but the location of the test sample raises issues. Clearly the stone was not moved before or after the glaze was created. The ceramic paste had to be heated whilst on the stone vestige. This means light would have to be reflected deep into the cave. Whilst it is possible that the ancients were capable of producing flat mirrors for the task, it does seem overly complicated. This method could work for stones on the surface, but is clearly limited in its use deep within a cave.

One last possibility is that the cave itself was a kiln. Pots or vases may have been fired in the cave and the ceramic pastes may have been applied to protect the stone mass of the structure. There is a lot of stone discoloration within the cave and innumerable glazed areas. There are several things that could confirm this view. There would be a route for the smoke to exit. There would be evidence of soot deposits, though they may have been washed away over the years. The comparison to Inca vestiges with vitrification found out in the open air or in places without a smoke escape, leaves many open questions**.**

On balance, it has to be admitted that a method is difficult to define. Further analysis of samples from the various locations needs to be undertaken to confirm the use of heat in all of the sites. However, the sample tested shows explicitly that the similarity to ceramic pastes is near certain. It is obvious to conclude that heat was used. The treatment method may have been similar to the technology used for ceramic pastes, only on a much larger scale. It is suggested that further investigations are carried out at the geochemical level to shed more light on what happened to these stones and what technology was used.

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-David Campbell, http://www.anarchaeology.com
-Paul D. Burley, http://www.pauldburley.com

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SUPPLEMENTS

1. Complete Data set:

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Tue Mar 30 10:54:26 2010

JP de Jong Andes Main body of Stone

Refit _K2-K' _K2-K" _Mn-K' _Mn-K" _SO-K' _SO-K" _Cl-K' _Cl-K"
Refit _Ca-K' _K2-K  _Cr-K  _P2-K
Filter Fit Method
Chi-sqd = 1.26     Livetime = 20.0 Sec.   Beam Current = 20.000 nA
Analysis With Standards                    Database:Maart2010
Element  Measured      Error        Net        Beam      Reference
          k-ratio    (2-Sigma)     Counts     Factor      Label
  Ca-K    0.36062  0.00694      43770      1.000      Ca-k-15kV20nADiopsie

PROZA Correction  Acc.Volt.= 15 kV  Take-off Angle=40.000 deg
Number of Iterations = 4

Element  k-ratio     Z      A     ZAF   Atom %  Element  Compound   No. of
                                                  Wt %      Wt %    Cations
  Si-K   0.00042  0.9930 1.2460 1.2276   0.095   0.051     0.109     0.0454
  Ti-K   0.00041  1.1493 1.1263 1.2943   0.057   0.053     0.088     0.0274
  Al-K   0.00007  1.0164 1.4281 1.4461   0.020   0.011     0.020     0.0097
  Fe-K   0.00042  1.1696 1.0362 1.2119   0.047   0.051     0.066     0.0227
  Mg-K   0.00172  0.9800 1.7455 1.7077   0.627   0.293     0.486     0.3005
  Ca-K   0.36062  1.0424 0.9996 1.0419  48.725  37.572    52.570    23.3505
  K -K   0.00000  1.0624 1.0084 0.9125   0.000   0.000     0.000     0.0001
  Na-K   0.00016  0.9975 2.3679 2.3602   0.086   0.038     0.051     0.0410
  Mn-K   0.00053  1.1868 1.0503 1.2465   0.063   0.067     0.086     0.0302
  Cr-K   0.00000  1.1606 1.0689 1.2405   0.000   0.000     0.000     0.0001
  S -K   0.00047  1.0104 1.0817 1.0602   0.080   0.049     0.123     0.0384
  Cl-K   0.00077  1.0604 1.0450 1.0486   0.118   0.081     0.081     0.0567
  P -K   0.00000  1.0319 1.1420 1.1596   0.000   0.000     0.000     0.0001
  O -K     ---    0.9022 7.7828 7.0211  50.081  15.415 S    ---       ---
  Total                               100.000  53.680    53.680    23.9226
   The number of cation results are based upon 24 Oxygen atoms

Tue Mar 30 10:58:09 2010

JP de Jong Andes 2 Main body of Stone

Refit _K2-K' _K2-K" _Mn-K' _Mn-K" _SO-K' _SO-K" _Cl-K' _Cl-K"
Refit _Si-K  _Al-K  _Ca-K' _K2-K  _Na-K  _Mn-K  _Cl-K  _P2-K
Refit _Ca-K" _SO-K
Filter Fit Method
Chi-sqd = 1.31     Livetime = 20.0 Sec.   Beam Current = 20.000 nA
Analysis With Standards                    Database:Maart2010
Element  Measured      Error        Net        Beam      Reference
          k-ratio    (2-Sigma)     Counts     Factor      Label
  Mg-K    0.00087  0.00047        201      1.000      Mg-k-15kV20nAPerikla
  Ca-K    0.36716  0.00580      44565      1.000      Ca-k-15kV20nADiopsie

PROZA Correction  Acc.Volt.= 15 kV  Take-off Angle=40.000 deg
Number of Iterations = 3

Element  k-ratio     Z      A     ZAF   Atom %  Element  Compound   No. of
                                                  Wt %      Wt %    Cations
  Si-K   0.00000  0.9923 1.2448 1.2254   0.000   0.000     0.000     0.0001
  Ti-K   0.00120  1.1483 1.1265 1.2933   0.167   0.155     0.259     0.0800
  Al-K   0.00000  1.0156 1.4265 1.4434   0.000   0.000     0.000     0.0001
  Fe-K   0.00099  1.1686 1.0367 1.2115   0.111   0.120     0.154     0.0530
  Mg-K   0.00087  0.9793 1.7514 1.7123   0.315   0.148     0.246     0.1509
  Ca-K   0.36716  1.0416 0.9989 1.0401  49.143  38.188    53.432    23.5324
  K -K   0.00000  1.0618 1.0076 0.9088   0.000   0.000     0.000     0.0001
```



```
  Na-K   0.00000  0.9968 2.3808 2.3714   0.001   0.000     0.000     0.0003
  Mn-K   0.00000  1.1858 1.0507 1.2459   0.000   0.000     0.000     0.0001
  Cr-K   0.00116  1.1599 1.0689 1.2396   0.143   0.144     0.211     0.0685
  S -K   0.00000  1.0097 1.0806 1.0578   0.000   0.000     0.000     0.0001
  Cl-K   0.00000  1.0596 1.0437 1.0452   0.000   0.000     0.000     0.0001
  P -K   0.00000  1.0313 1.1416 1.1585   0.000   0.000     0.000     0.0001
  O -K     ---    0.9017 7.7990 7.0318  50.120  15.547 S    ---       ---
  Total                               100.000  54.304    54.304    23.8855
   The number of cation results are based upon 24 Oxygen atoms

Tue Mar 30 11:06:50 2010

JP de Jong Andes 3 Border Black

Refit _K2-K' _K2-K" _Mn-K' _Mn-K" _SO-K' _SO-K" _Cl-K' _Cl-K"
Refit _Ca-K" _K2-K  _Cr-K  _SO-K
Filter Fit Method
Chi-sqd = 1.71     Livetime = 20.0 Sec.   Beam Current = 20.000 nA
Analysis With Standards                    Database:Maart2010
Element  Measured      Error        Net        Beam      Reference
          k-ratio    (2-Sigma)     Counts     Factor      Label
  Mg-K    0.00076  0.00047        175      1.000      Mg-k-15kV20nAPerikla
  Ca-K    0.37648  0.00591      45696      1.000      Ca-k-15kV20nADiopsie

PROZA Correction  Acc.Volt.= 15 kV  Take-off Angle=40.000 deg
Number of Iterations = 4

Element  k-ratio     Z      A     ZAF   Atom %  Element  Compound   No. of
                                                 Wt %      Wt %    Cations
  Si-K   0.00011  0.9928 1.2455 1.2267   0.024   0.013     0.029     0.0115
  Ti-K   0.00041  1.1490 1.1269 1.2947   0.055   0.053     0.088     0.0265
  Al-K   0.00039  1.0162 1.4261 1.4437   0.105   0.057     0.107     0.0505
  Fe-K   0.00042  1.1693 1.0364 1.2118   0.046   0.051     0.066     0.0221
  Mg-K   0.00076  0.9798 1.7492 1.7109   0.267   0.129     0.214     0.1281
  Ca-K   0.37648  1.0422 0.9990 1.0410  49.149  39.193    54.838    23.5646
  K -K   0.00000  1.0623 1.0077 0.9093   0.000   0.000     0.000     0.0001
  Na-K   0.00037  0.9973 2.3718 2.3636   0.189   0.087     0.117     0.0908
  Mn-K   0.00047  1.1865 1.0505 1.2464   0.054   0.059     0.076     0.0258
  Cr-K   0.00000  1.1604 1.0691 1.2406   0.000   0.000     0.000     0.0001
  S -K   0.00000  1.0101 1.0808 1.0585   0.000   0.000     0.000     0.0001
  Cl-K   0.00001  1.0600 1.0439 1.0458   0.001   0.001     0.001     0.0005
  P -K   0.00027  1.0318 1.1423 1.1599   0.052   0.032     0.073     0.0247
  O -K     ---    0.9020 7.8092 7.0440  50.057  15.934 S    ---       ---
  Total                               100.000  55.609    55.609    23.9454
   The number of cation results are based upon 24 Oxygen atoms

Tue Mar 30 11:10:57 2010

JP de Jong Andes 4 Border 5 micron spot

Refit _K2-K' _K2-K" _Mn-K' _Mn-K" _SO-K' _SO-K" _Cl-K' _Cl-K"
Refit _Mn-K
Filter Fit Method
Chi-sqd = 3.49     Livetime = 20.0 Sec.   Beam Current = 20.000 nA
Analysis With Standards                    Database:Maart2010
Element  Measured      Error        Net        Beam      Reference
          k-ratio    (2-Sigma)     Counts     Factor      Label
  Si-K    0.03738  0.00092       9481      1.000      Si-k-15kV20nAKwarts
  Al-K    0.01765  0.00069       4723      1.000      Al-k-15kV20nACorund
  Fe-K    0.00833  0.00200        381      1.000      Fe-k-15kV20nAHematie
  Mg-K    0.01202  0.00063       2780      1.000      Mg-k-15kV20nAPerikla
  Ca-K    0.25413  0.00566      30845      1.000      Ca-k-15kV20nADiopsie
  K -K    0.00299  0.00095        403      1.000      K-k-15kV20nAKTiPO5
  Na-K    0.00087  0.00046        135      1.000      Na-k-15kV20nAJadeiet
  S -K    0.00250  0.00070        502      1.000      S-k-Chalcopyriet
  Cl-K    0.00156  0.00071        235      1.000      Cl-k-KCl
  P -K    0.00431  0.00073        904      1.000      P-k-15kV20nAKTiPO5
```


PROZA Correction Acc.Volt.= 15 kV Take-off Angle=40.000 deg
Number of Iterations = 4

Element	k-ratio	Z	A	ZAF	Atom %	Element Wt %	Compound Wt %	No. of Cations
Si-K	0.03738	1.0075	1.2778	1.2810	6.972	4.789	10.245	3.0360
Ti-K	0.00023	1.1678	1.0903	1.2722	0.025	0.029	0.048	0.0107
Al-K	0.01765	1.0311	1.4096	1.4466	3.868	2.553	4.823	1.6844
Fe-K	0.00833	1.1903	1.0232	1.2179	0.743	1.014	1.305	0.3234
Mg-K	0.01202	0.9941	1.6521	1.6372	3.312	1.968	3.264	1.4420
Ca-K	0.25413	1.0588	1.0192	1.0785	27.962	27.408	38.349	12.1755
K -K	0.00299	1.0790	1.0330	1.0318	0.323	0.309	0.372	0.1407
Na-K	0.00087	1.0118	2.1944	2.2163	0.342	0.192	0.259	0.1488
Mn-K	0.00000	1.2040	1.0357	1.2470	0.000	0.000	0.000	0.0000
Cr-K	0.00034	1.1804	1.0472	1.2336	0.033	0.042	0.061	0.0144
S -K	0.00250	1.0254	1.1464	1.1578	0.370	0.290	0.724	0.1610
Cl-K	0.00156	1.0763	1.0925	1.1445	0.206	0.179	0.179	0.0898
P -K	0.00431	1.0472	1.2291	1.2763	0.726	0.550	1.259	0.3159
O -K	---	0.9132	6.0038	5.4822	55.119	21.566 S	---	---
Total					100.000	60.889	60.889	19.5425

The number of cation results are based upon 24 Oxygen atoms

Tue Mar 30 11:15:36 2010

JP de Jong Andes 5 Border narrower spot

Refit _K2-K' _K2-K" _Mn-K' _Mn-K" _SO-K' _SO-K" _Cl-K' _Cl-K"
Refit _Mn-K
Filter Fit Method
Chi-sqd = 3.03 Livetime = 20.0 Sec. Beam Current = 20.000 nA
Analysis With Standards Database:Maart2010

Element	Measured k-ratio	Error (2-Sigma)	Net Counts	Beam Factor	Reference Label
Si-K	0.04404	0.00097	11168	1.000	Si-k-15kV20nAKwarts
Al-K	0.02244	0.00075	6005	1.000	Al-k-15kV20nACorund
Fe-K	0.00979	0.00215	448	1.000	Fe-k-15kV20nAHematie
Mg-K	0.01200	0.00063	2776	1.000	Mg-k-15kV20nAPerikla
Ca-K	0.25756	0.00570	31261	1.000	Ca-k-15kV20nADiopsie
K -K	0.00372	0.00094	500	1.000	K-k-15kV20nAKTiPO5
S -K	0.00283	0.00070	567	1.000	S-k-Chalcopyriet
Cl-K	0.00217	0.00072	327	1.000	Cl-k-KCl
P -K	0.00420	0.00071	882	1.000	P-k-15kV20nAKTiPO5

PROZA Correction Acc.Volt.= 15 kV Take-off Angle=40.000 deg
Number of Iterations = 4

Element	k-ratio	Z	A	ZAF	Atom %	Element Wt %	Compound Wt %	No. of Cations
Si-K	0.04404	1.0083	1.2807	1.2852	7.615	5.660	12.108	3.2843
Ti-K	0.00169	1.1689	1.0868	1.2690	0.170	0.215	0.358	0.0731
Al-K	0.02244	1.0319	1.4018	1.4395	4.523	3.230	6.103	1.9509
Fe-K	0.00979	1.1915	1.0223	1.2180	0.807	1.193	1.535	0.3481
Mg-K	0.01200	0.9949	1.6445	1.6307	3.043	1.957	3.246	1.3126
Ca-K	0.25756	1.0597	1.0212	1.0813	26.256	27.849	38.966	11.3243
K -K	0.00372	1.0799	1.0353	1.0408	0.374	0.387	0.466	0.1612
Na-K	0.00054	1.0126	2.1853	2.2087	0.195	0.119	0.160	0.0842
Mn-K	0.00000	1.2051	1.0343	1.2465	0.000	0.000	0.000	0.0000
Cr-K	0.00064	1.1816	1.0455	1.2323	0.057	0.078	0.115	0.0246
S -K	0.00283	1.0262	1.1520	1.1655	0.389	0.330	0.823	0.1676
Cl-K	0.00217	1.0772	1.0965	1.1518	0.267	0.250	0.250	0.1150
P -K	0.00420	1.0480	1.2379	1.2872	0.660	0.541	1.239	0.2846
O -K	---	0.9140	5.8344	5.3316	55.645	23.561 S	---	---
Total					100.000	65.369	65.369	19.1304

The number of cation results are based upon 24 Oxygen atoms

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JP de Jong Andes Surface

Refit _K2-K' _K2-K" _Mn-K' _Mn-K" _Cl-K' _Cl-K"
Refit _Ca-K' _Cr-K  _SO-K' _SO-K"
Filter Fit Method
Chi-sqd = 1.75     Livetime = 20.0 Sec.   Beam Current = 20.000 nA
Analysis With Standards                    Database:Maart2010
Element  Measured      Error        Net        Beam      Reference
          k-ratio    (2-Sigma)     Counts     Factor      Label
  Si-K    0.04981  0.00101      12633      1.000      Si-k-15kV20nAKwarts
  Ti-K    0.00172  0.00095        156      1.000      Ti-k-15kV20nATiO
  Al-K    0.01551  0.00067       4152      1.000      Al-k-15kV20nACorund
  Fe-K    0.00615  0.00192        282      1.000      Fe-k-15kV20nAHematie
  Mg-K    0.00728  0.00057       1684      1.000      Mg-k-15kV20nAPerikla
  Ca-K    0.24048  0.00546      29189      1.000      Ca-k-15kV20nADiopsie
  K -K    0.00317  0.00092        427      1.000      K-k-15kV20nAKTiPO5
  Na-K    0.00109  0.00047        170      1.000      Na-k-15kV20nAJadeiet
  S -K    0.00499  0.00073       1001      1.000      S-k-Chalcopyriet
  P -K    0.00631  0.00075       1324      1.000      P-k-15kV20nAKTiPO5

PROZA Correction  Acc.Volt.= 15 kV  Take-off Angle=40.000 deg
Number of Iterations = 4

Element  k-ratio     Z      A     ZAF   Atom %  Element  Compound   No. of
                                                 Wt %      Wt %    Cations
  Si-K   0.04981  1.0103 1.2565 1.2631   8.916   6.292    13.460     3.7786
  Ti-K   0.00172  1.1714 1.0866 1.2721   0.182   0.219     0.366     0.0772
  Al-K   0.01551  1.0340 1.3860 1.4252   3.261   2.210     4.177     1.3819
  Fe-K   0.00615  1.1941 1.0222 1.2205   0.535   0.751     0.966     0.2268
  Mg-K   0.00728  0.9969 1.6432 1.6324   1.947   1.189     1.971     0.8249
  Ca-K   0.24048  1.0619 1.0219 1.0844  25.897  26.078    36.489    10.9750
  K -K   0.00317  1.0821 1.0361 1.0449   0.337   0.331     0.399     0.1429
  Na-K   0.00109  1.0146 2.1771 2.2050   0.415   0.239     0.323     0.1757
  Mn-K   0.00009  1.2111 1.0315 1.2492   0.008   0.012     0.015     0.0036
  Cr-K   0.00000  1.1813 1.0483 1.2365   0.000   0.000     0.000     0.0000
  S -K   0.00499  1.0283 1.1530 1.1692   0.725   0.584     1.458     0.3072
  Cl-K   0.00079  1.0793 1.0995 1.1578   0.103   0.092     0.092     0.0437
  P -K   0.00631  1.0501 1.2346 1.2862   1.042   0.811     1.858     0.4417
  O -K     ---    0.9161 5.7955 5.3083  56.631  22.765 S    ---       ---
  Total                               100.000  61.574    61.574    18.3793

   The number of cation results are based upon 24 Oxygen atoms


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JP de Jong Andes Surface

Refit _K2-K' _K2-K" _Mn-K' _Mn-K" _Cl-K' _Cl-K"
Refit _Ca-K' _Cr-K  _SO-K' _SO-K"
Filter Fit Method
Chi-sqd = 1.75     Livetime = 20.0 Sec.   Beam Current = 20.000 nA
Analysis With Standards                    Database:Maart2010
Element  Measured      Error        Net        Beam      Reference
          k-ratio    (2-Sigma)     Counts     Factor      Label
  Si-K    0.04981  0.00101      12633      1.000      Si-k-15kV20nAKwarts
  Ti-K    0.00172  0.00095        156      1.000      Ti-k-15kV20nATiO
  Al-K    0.01551  0.00067       4152      1.000      Al-k-15kV20nACorund
  Fe-K    0.00615  0.00192        282      1.000      Fe-k-15kV20nAHematie
  Mg-K    0.00728  0.00057       1684      1.000      Mg-k-15kV20nAPerikla
  Ca-K    0.24048  0.00546      29189      1.000      Ca-k-15kV20nADiopsie
  K -K    0.00317  0.00092        427      1.000      K-k-15kV20nAKTiPO5
  Na-K    0.00109  0.00047        170      1.000      Na-k-15kV20nAJadeiet
  S -K    0.00499  0.00073       1001      1.000      S-k-Chalcopyriet
  P -K    0.00631  0.00075       1324      1.000      P-k-15kV20nAKTiPO5
```

PROZA Correction Acc.Volt.= 15 kV Take-off Angle=40.000 deg
Number of Iterations = 4

Element	k-ratio	Z	A	ZAF	Atom %	Element Wt %	Compound Wt %	No. of Cations
Si-K	0.04981	1.0103	1.2565	1.2631	8.916	6.292	13.460	3.7786
Ti-K	0.00172	1.1714	1.0866	1.2721	0.182	0.219	0.366	0.0772
Al-K	0.01551	1.0340	1.3860	1.4252	3.261	2.210	4.177	1.3819
Fe-K	0.00615	1.1941	1.0222	1.2205	0.535	0.751	0.966	0.2268
Mg-K	0.00728	0.9969	1.6432	1.6324	1.947	1.189	1.971	0.8249
Ca-K	0.24048	1.0619	1.0219	1.0844	25.897	26.078	36.489	10.9750
K -K	0.00317	1.0821	1.0361	1.0449	0.337	0.331	0.399	0.1429
Na-K	0.00109	1.0146	2.1771	2.2050	0.415	0.239	0.323	0.1757
Mn-K	0.00009	1.2111	1.0315	1.2492	0.008	0.012	0.015	0.0036
Cr-K	0.00000	1.1813	1.0483	1.2365	0.000	0.000	0.000	0.0000
S -K	0.00499	1.0283	1.1530	1.1692	0.725	0.584	1.458	0.3072
Cl-K	0.00079	1.0793	1.0995	1.1578	0.103	0.092	0.092	0.0437
P -K	0.00631	1.0501	1.2346	1.2862	1.042	0.811	1.858	0.4417
O -K	---	0.9161	5.7955	5.3083	56.631	22.765 S	---	---
Total					100.000	61.574	61.574	18.3793

The number of cation results are based upon 24 Oxygen atoms

Tue Mar 30 11:51:10 2010

Outer Border 1 Micrometer spot

Refit _Mn-K' _Mn-K" _Cl-K' _Cl-K"
Refit _Ca-K' _Ca-K" _K2-K' _Cr-K _SO-K' _SO-K"
Filter Fit Method
Chi-sqd = 3.60   Livetime = 20.0 Sec.   Beam Current = 20.000 nA
Analysis With Standards   Database:Maart2010

Element	Measured k-ratio	Error (2-Sigma)	Net Counts	Beam Factor	Reference Label
Si-K	0.08207	0.00126	20814	1.000	Si-k-15kV20nAKwarts
Ti-K	0.00145	0.00096	131	1.000	Ti-k-15kV20nATiO
Al-K	0.02883	0.00082	7718	1.000	Al-k-15kV20nACorund
Fe-K	0.01427	0.00222	653	1.000	Fe-k-15kV20nAHematie
Mg-K	0.01449	0.00067	3352	1.000	Mg-k-15kV20nAPerikla
Ca-K	0.17883	0.00341	21706	1.000	Ca-k-15kV20nADiopsie
K -K	0.00558	0.00197	750	1.000	K-k-15kV20nAKTiPO5
S -K	0.00434	0.00071	870	1.000	S-k-Chalcopyriet
P -K	0.00963	0.00080	2022	1.000	P-k-15kV20nAKTiPO5

PROZA Correction Acc.Volt.= 15 kV Take-off Angle=40.000 deg
Number of Iterations = 4

Element	k-ratio	Z	A	ZAF	Atom %	Element Wt %	Compound Wt %	No. of Cations
Si-K	0.08207	1.0182	1.2734	1.2920	12.529	10.603	22.684	5.0952
Ti-K	0.00145	1.1815	1.0658	1.2571	0.126	0.182	0.304	0.0513
Al-K	0.02883	1.0420	1.3741	1.4229	5.047	4.103	7.752	2.0522
Fe-K	0.01427	1.2053	1.0146	1.2230	1.037	1.745	2.245	0.4217
Mg-K	0.01449	1.0046	1.5918	1.5922	3.151	2.308	3.827	1.2813
Ca-K	0.17883	1.0708	1.0334	1.1054	16.369	19.768	27.659	6.6564
K -K	0.00558	1.0911	1.0501	1.0983	0.520	0.613	0.738	0.2115
Na-K	0.00056	1.0225	2.0928	2.1346	0.172	0.119	0.161	0.0699
Mn-K	0.00093	1.2221	1.0218	1.2487	0.070	0.116	0.150	0.0286
Cr-K	0.00000	1.1916	1.0355	1.2293	0.000	0.000	0.000	0.0000
S -K	0.00434	1.0365	1.1950	1.2283	0.552	0.534	1.332	0.2246
Cl-K	0.00005	1.0854	1.1212	1.1962	0.005	0.006	0.006	0.0022
P -K	0.00963	1.0584	1.2908	1.3595	1.403	1.309	3.000	0.5705
O -K	---	0.9229	4.6476	4.2885	59.018	28.452 S	---	---
Total					100.000	69.858	69.858	16.6654

The number of cation results are based upon 24 Oxygen atoms

Tue Mar 30 11:59:01 2010

Outer Border 1 Micrometer spot

Refit _Mn-K' _Mn-K" _SO-K' _SO-K" _Cl-K' _Cl-K"
Refit _Ca-K' _Ca-K" _K2-K' _K2-K"
Filter Fit Method
Chi-sqd = 7.88 Livetime = 20.0 Sec. Beam Current = 20.000 nA
Analysis With Standards Database:Maart2010

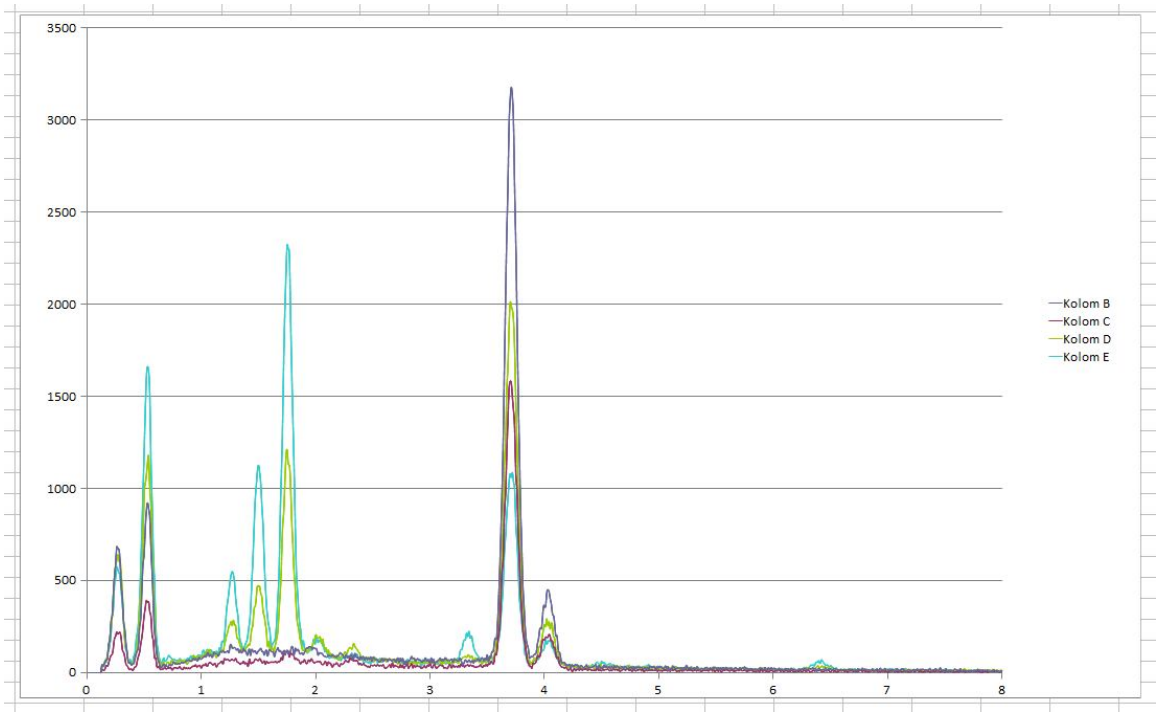
Element	Measured k-ratio	Error (2-Sigma)	Net Counts	Beam Factor	Reference Label
Si-K	0.13667	0.00161	34660	1.000	Si-k-15kV20nAKwarts
Ti-K	0.00067	0.00094	61	1.000	Ti-k-15kV20nATiO
Al-K	0.04848	0.00102	12978	1.000	Al-k-15kV20nACorund
Fe-K	0.01800	0.00239	824	1.000	Fe-k-15kV20nAHematie
Mg-K	0.03311	0.00087	7657	1.000	Mg-k-15kV20nAPerikla
Ca-K	0.08283	0.00215	10054	1.000	Ca-k-15kV20nADiopsie
K -K	0.00619	0.00089	833	1.000	K-k-15kV20nAKTiPO5
Na-K	0.00079	0.00051	123	1.000	Na-k-15kV20nAJadeiet
Mn-K	0.00077	0.00133	44	1.000	Mn-k-15kV20nATephroi
Cr-K	0.00023	0.00124	15	1.000	Cr-k-15kV20nAChroom
S -K	0.00216	0.00066	433	1.000	S-k-Chalcopyriet
Cl-K	0.00146	0.00066	219	1.000	Cl-k-KCl
P -K	0.00526	0.00074	1105	1.000	P-k-15kV20nAKTiPO5

PROZA Correction Acc.Volt.= 15 kV Take-off Angle=40.000 deg
Number of Iterations = 5

Element	k-ratio	Z	A	ZAF	Atom %	Element Wt %	Compound Wt %	No. of Cations
Si-K	0.13667	1.0309	1.2966	1.3346	17.419	18.240	39.021	6.8582
Ti-K	0.00067	1.1974	1.0403	1.2426	0.047	0.084	0.140	0.0185
Al-K	0.04848	1.0549	1.3633	1.4276	6.881	6.922	13.078	2.7091
Fe-K	0.01800	1.2229	1.0067	1.2311	1.064	2.216	2.851	0.4190
Mg-K	0.03311	1.0170	1.5049	1.5218	5.561	5.039	8.356	2.1894
Ca-K	0.08283	1.0849	1.0463	1.1339	6.285	9.392	13.141	2.4746
K -K	0.00619	1.1053	1.0685	1.1622	0.494	0.720	0.867	0.1944
Na-K	0.00079	1.0351	1.9385	1.9994	0.184	0.157	0.212	0.0723
Mn-K	0.00077	1.2395	1.0101	1.2520	0.047	0.096	0.124	0.0185
Cr-K	0.00023	1.2114	1.0167	1.2243	0.015	0.029	0.042	0.0058
S -K	0.00216	1.0496	1.2472	1.3045	0.236	0.282	0.704	0.0928
Cl-K	0.00146	1.1019	1.1609	1.2716	0.140	0.185	0.185	0.0551
P -K	0.00526	1.0717	1.3770	1.4727	0.671	0.775	1.777	0.2643
O -K	---	0.9349	3.2168	3.0064	60.957	36.361 S	---	---
Total					100.000	80.498	80.498	15.3721

The number of cation results are based upon 24 Oxygen atoms

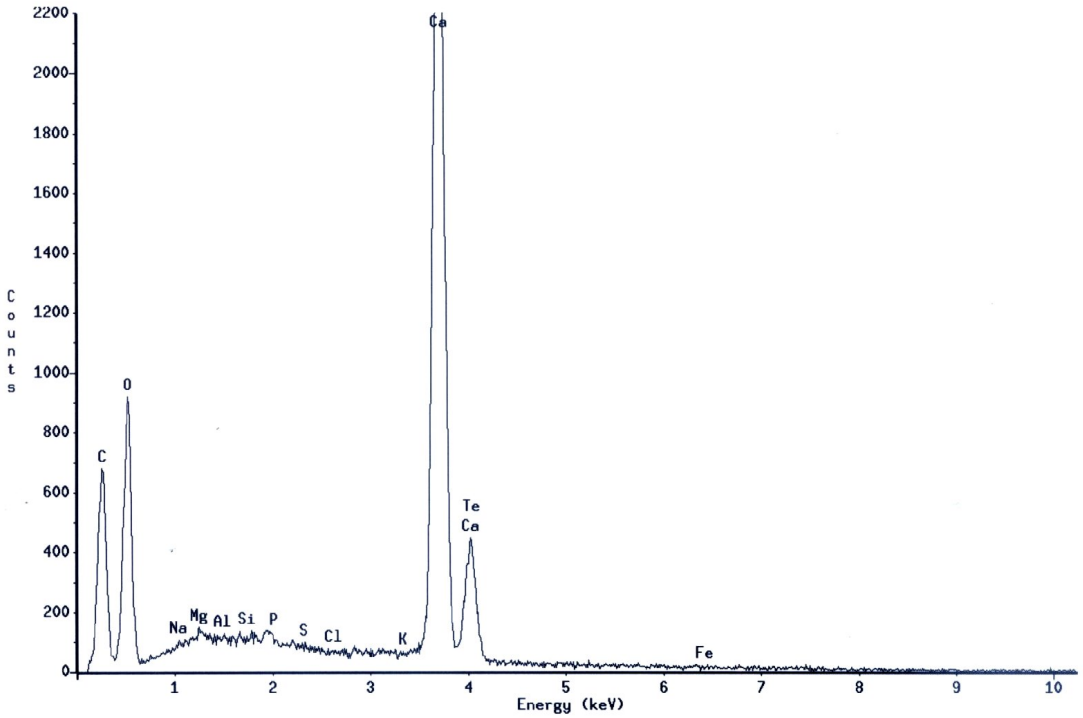
2. Graphics from Excel



Column B= Main Body
Column C= Below Surface, body
Column D= Spot on surface 1
Column E= Spot on surface 2

For complete Excel file, ask by email: jpdejong@hotmail.com

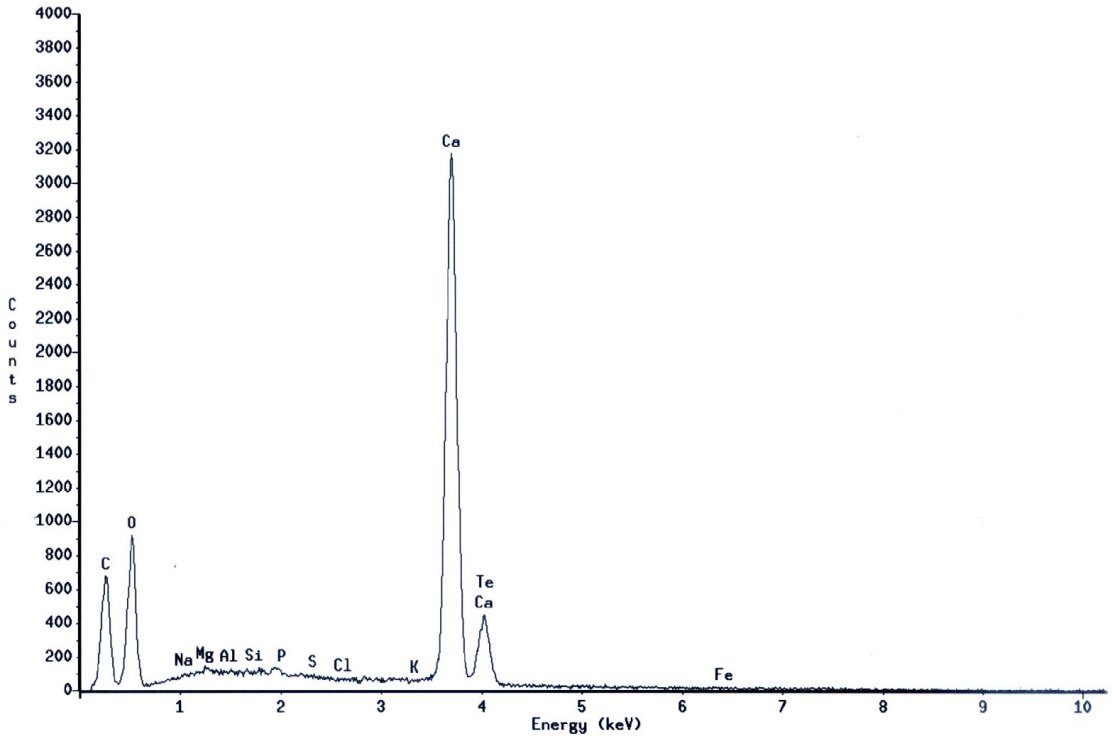
3. Other graphics, printed on moment of measurement



Column	: JXA_8600,Pioneer		
Take-off angle	: 40	Accelerating voltage	: 15
Acquisition type	: eds	Magnification	: 170
Creation time	: 2010/03/30 11:33	Charge	: 400
Livetime	: 20	Beam current	: 20
Deadtime	: 1.983	Beam spot size	: 0
Channels	: 1024	Beam location	: 0,0
Channel width	: 10	Working distance	: 11
Detector type	: Silicon/Lithium	Stage X	: 17.662
Window type	: norvar	Stage Y	: 56.544
Window thickness	: 0.3	Stage Z	: 11.433
Coating material	: Al	Stage tilt	: 0
Coating thickness	: 0.04	Stage rotation	: 0
Contact material	: Au	Contamination material	: none
Contact thickness	: 0.02	Contamination thickness	: 0
Crystal thickness	: 3		

File name : /usr/home/voyager/spectra/JPdeJongAndesKern.eds

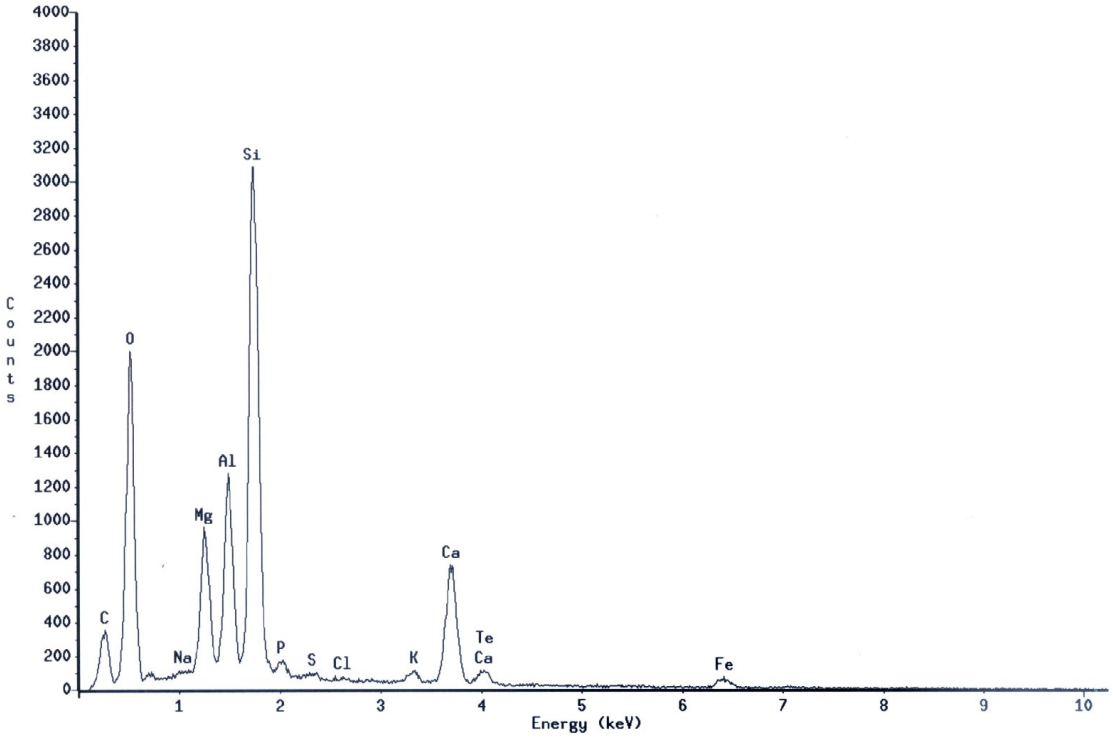
Inside of sample 1



Column	: JXA_8600,Pioneer		
Take-off angle	: 40	Accelerating voltage	: 15
Acquisition type	: eds	Magnification	: 170
Creation time	: 2010/03/30 11:33	Charge	: 400
Livetime	: 20	Beam current	: 20
Deadtime	: 1.983	Beam spot size	: 0
Channels	: 1024	Beam location	: 0,0
Channel width	: 10	Working distance	: 11
Detector type	: Silicon/Lithium	Stage X	: 17.662
Window type	: norvar	Stage Y	: 56.544
Window thickness	: 0.3	Stage Z	: 11.433
Coating material	: Al	Stage tilt	: 0
Coating thickness	: 0.04	Stage rotation	: 0
Contact material	: Au	Contamination material	: none
Contact thickness	: 0.02	Contamination thickness	: 0
Crystal thickness	: 3		

File name : /usr/home/voyager/spectra/JPdeJongAndesKern.eds

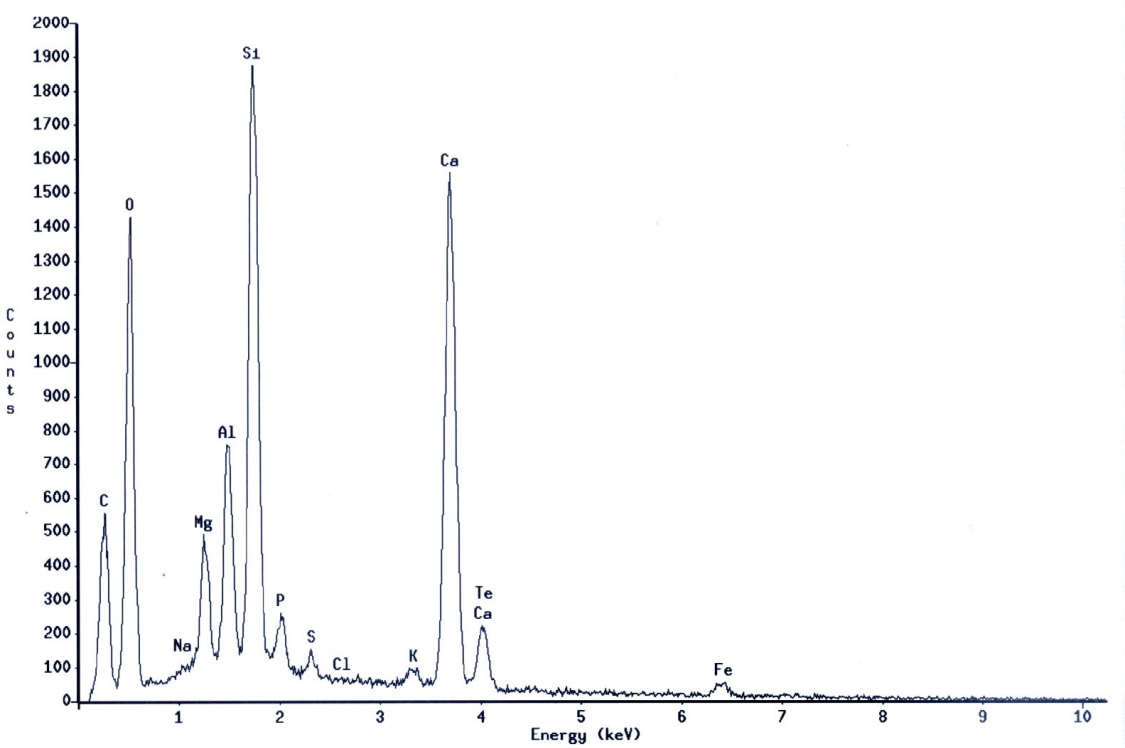
Inside of sample 2



Column	: JXA_8600,Pioneer		
Take-off angle	: 40	Accelerating voltage	: 15
Acquisition type	: eds	Magnification	: 5000
Creation time	: 2010/03/30 11:58	Charge	: 400
Livetime	: 20	Beam current	: 20
Deadtime	: 2.384	Beam spot size	: 0
Channels	: 1024	Beam location	: 0,0
Channel width	: 10	Working distance	: 11
Detector type	: Silicon/Lithium	Stage X	: 15.995
Window type	: norvar	Stage Y	: 48.376
Window thickness	: 0.3	Stage Z	: 11.434
Coating material	: Al	Stage tilt	: 0
Coating thickness	: 0.04	Stage rotation	: 0
Contact material	: Au	Contamination material	: none
Contact thickness	: 0.02	Contamination thickness	: 0
Crystal thickness	: 3		

File name :

Layer of sample 1



Column	: JXA_8600,Pioneer		
Take-off angle	: 40	Accelerating voltage	: 15
Acquisition type	: eds	Magnification	: 2300
Creation time	: 2010/03/30 11:50	Charge	: 400
Livetime	: 20	Beam current	: 20
Deadtime	: 2.157	Beam spot size	: 0
Channels	: 1024	Beam location	: 0,0
Channel width	: 10	Working distance	: 11
Detector type	: Silicon/Lithium	Stage X	: 16.086
Window type	: norvar	Stage Y	: 48.424
Window thickness	: 0.3	Stage Z	: 11.434
Coating material	: Al	Stage tilt	: 0
Coating thickness	: 0.04	Stage rotation	: 0
Contact material	: Au	Contamination material	: none
Contact thickness	: 0.02	Contamination thickness	: 0
Crystal thickness	: 3		

File name : /usr/home/voyager/spectra/JPdeJongAndesrand.eds

Layer of sample 2