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# THE EXAMINATION OF SUEVITE FROM THE BOSUMTWI IMPACT CRATER (GHANA)

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## ABSTRACT

That meteorite has probably been hitted one million years ago – which created the Bosumtwi Meteoritic Crater in Ghana. Because of the hit suevite stone came into being and it can be found there today, too. It is a supposition that an ferro meteorite hitted but it was proved only indirectly according to literary sources.

A Hungarian searching group went to the crater and we examined the gathered suevite stonesamples. The original supposition is proved by the meltability research, the surface-research and microanalisis by scanning electronmicroscope and the results of X-ray diffraction research.

## THE ORIGIN OF ROCK SAMPLES

The Bosumtwi Meteoritic Crater (Ghana) can be found 30 kilometers from Kumasi town into the South–East. The crater is nearly like a circle, its extension is 11 kms in North–South and 10 kms in East–West. There is a lake in the crater, its deepest point is about 80 m. The edge of the crater is nearly 250–300 ms above the surface of the water (JONES et al. 1981).

The crater was probably made by a 300 m of diameter meteorite at about one million years ago. Its speed was 24,6 km/s (SHOEMAKER, 1977). It was counted that its mass was $10^8$ t, the kinetic energy $3x10^{19}$ joules. An immense heat occured because of the bumping against the earth and the blowing up of meteorite. The earthly material had melted and the meteorite together with its material flew about 300 kms while tektites appeared (BARNES, 1961; and COHEN, 1963). The mass of microtektites in Ivory Coast – ivorites – is about $2x10^7$ t (GLASS, 1979). It is one scale smaller than the mass of the hitted meteorite.

Because of the hit, the enormous heat and the effect of pressure suevite stone appeared, and it can be found in spots to the North–South extension from the crater. The geographical place of the crater and the occurences of suevite are shown in the *Fig. 1*.

Suevite is a dark-grey stone similar to pumiceous tuff. It contains coesite – a $SiO_2$ variety coming into being under high strain (LITTER, 1962), nickel-iron spherules (EL GORESY, 1966), crumbled quartz (CHAO, 1968), melted ilmenite – $FeTiO_3$ – and zircon decomposed into baddeleyite (EL GORESY, 1968).

A group of Hungarian researchers has gone to Ghana in 1993 to examine the meteorite crater of Bosumtwi. I have got a sample from suevite stone and we examined the meltabling, surface, chemical composition and quantity of the components, and the crystallinity.

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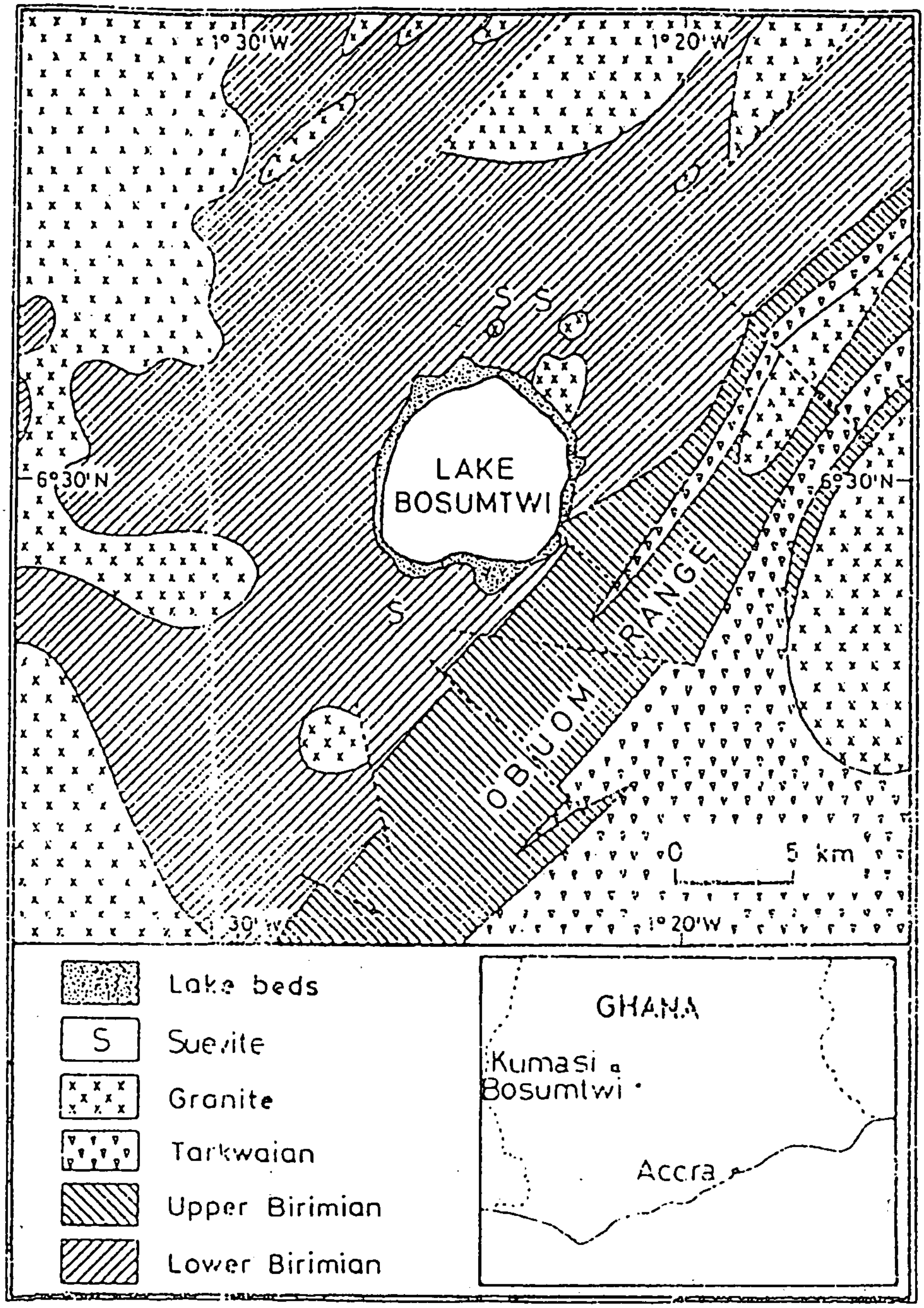


*Fig. 1.* The Bosumtwi impact crater (Ghana). Quarries of suevite.

## MELTABILITY RESEARCH

As the suevite came into being in high temperature I did the meltability research, too. I broke a small chip of some mms piece from the examined material. I put it onto a platinum loop and hot by a jet flame. I made the examine by a precision apparatus working by butan gas so 1500 °C can be reached.

Before and after heating for some minutes I examined the surface in a 30 times enlargement with a SUNRISE hand-microscope considering the peaked parts. I discovered that the sample-piece melted in this temperature but it was not shriveled into a ball. The originally blistering surface did not bulk but its colour became darker.

## RESEARCH WITH ELECTRONMICROSCOPE

*Surface-research*

We made the examination by scanning electronmicroscope. The equipment works in the University of Miskolc, in the Metallurgical Chair and is an American AMRAY 1830 I. type. We broke 3 pieces of some millimeters in expansion chips. To get well – perceptible photoes we made the surface electronically conductor by vapouring a thin gold layer. The secunder electrons gave sharp and large disintegrated pictures from the relief of our sample. The pictures were big profoundnessly sharp and made stereoscopic. The photographs showed it quite well (*Fig. 2a, 4a, 4b*).

The sizes of photos are 100 mm x 65 mm. The text below contains the measure of enlargement, the accelator voltage of electron gun, the measure rate, the name, the time of photo and the serial number.

*The Evaluation of Photographs*

It was visible to the naked eyes that the stone-sample is not homogeneous. The inner part is porous, like tuff while the outer side remembers to a conglomerate. One side of the sample was rudely polished. Opposite to the mentioned polished side one can see that the stone material is nearly homogeneous in structure.

Outer side of the sample is characterized by three photos. *Fig. 2b* shows that the structure is cracked, it remembers to a conglomerate. On the *Fig. 3b* the structure is porous, on the surface of blister sheeted separation can be found. It was examined the smooth melted surface and the separated sheet by microbougie. On the *Fig. 4b* it can be seen that the balls would melt; the inside part is porous. Increase of the enlargement has not given new informations.

Inner side of the sample is also characterized by three photos. *Fig. 2a* shows that the structure is porous. It is visible on the *Fig. 4a* that the structure is spongy, the melting part was blistered before cooling by gas. Surface of the fracture was examined by microbougie. It can be seen well on the *Fig. 3a* that in the inner surface of the blister there is a cover. The 1$^{st}$ and 2$^{nd}$ points were examined by microbougie. Increase of the enlargement has not given new informations.

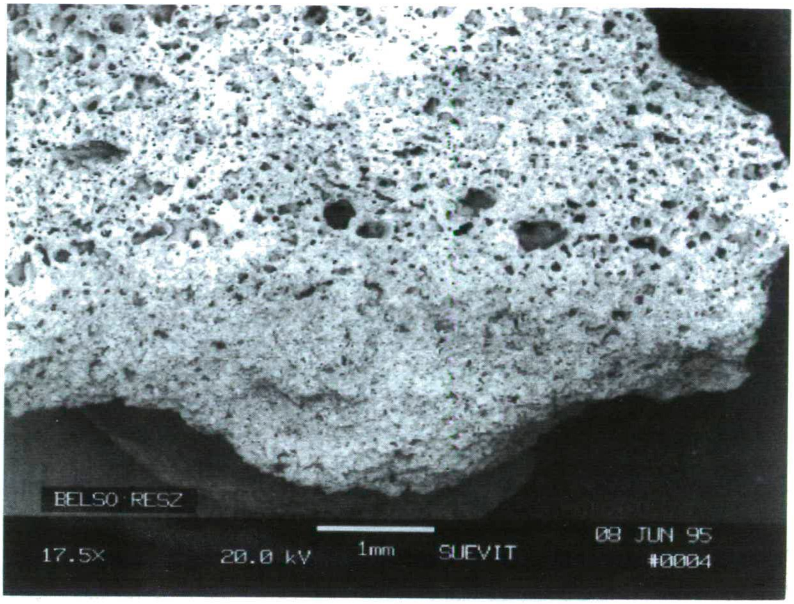


*Fig. 2a.* Inner part of the sample

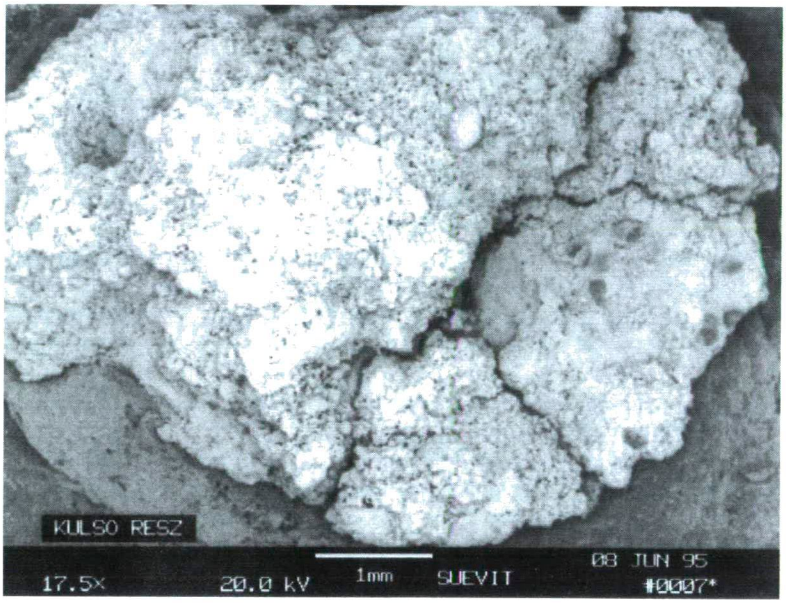


*Fig. 2b.* Outer part of the sample

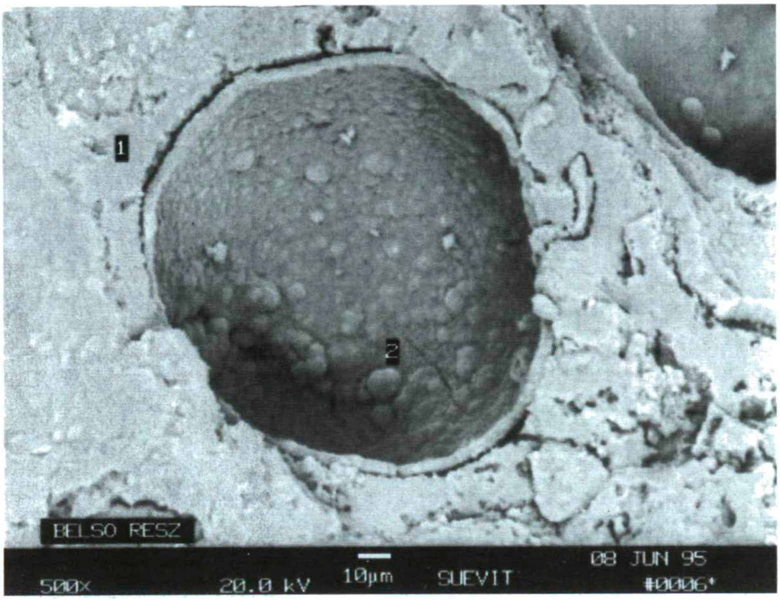


*Fig. 3a.* The inner surface of blister

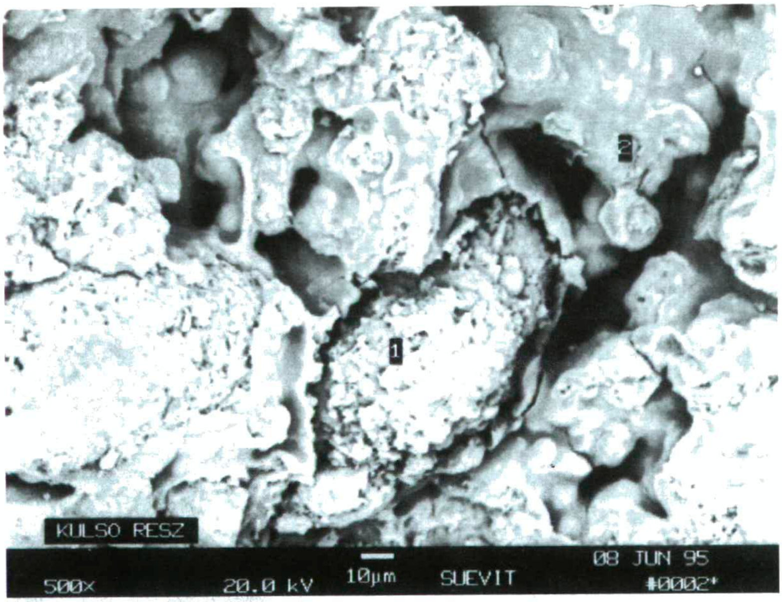


*Fig. 3b.* On the surface of blister sheeted separation can be found

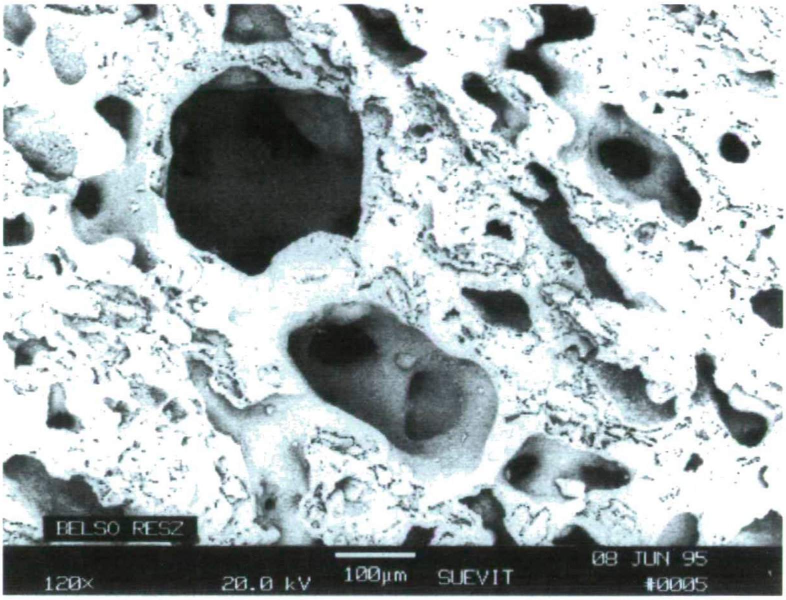


*Fig. 4a.* The structure is spongy

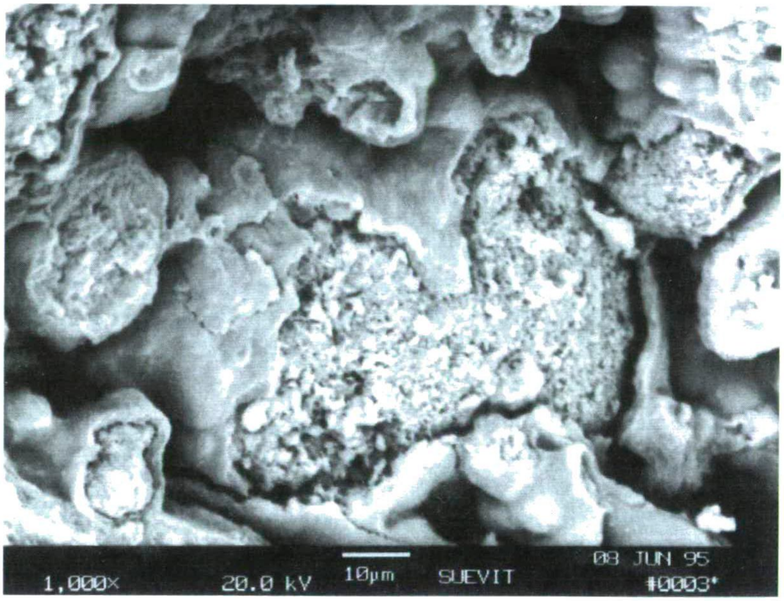


*Fig. 4b.* As the balls would have melted

## CHEMICAL COMBINATION RESEARCH BY MICROBOUGIE

Used electronmicroscope can be utilized as electronray microanalyser (electron-microbougie) over the research of surface. The research was carried out by spread-back electrons. (We broke through the depth of 0,1–1 μm). With the help of energy-dispersive microbougie the given sample can be examined from serial number of 11 to 92. That means, there was no possibility to determine the carbon, nitrogen and oxygen content.

We add the microbougie spectrum made from the marked points of *Fig. 3a (Fig. 5)* and one can read: The disintegration of horizontal shaft 10 electron V/pipe, the researching time was 40 sec by measuring points.

The combination converted into their oxyds in the measuring points are summarized in the Table 1.

TABLE 1

| Component | Fig. 4a % | Fig. 3a/1 % | Fig. 3a/2 % | Fig. 3b/1 % | Fig. 3b/2 % |
|---|---|---|---|---|---|
| $SiO_2$ | 53.57 | 54.76 | 32.33 | 61.02 | 59.16 |
| $Al_2O_3$ | 33.85 | 30.53 | 19.46 | 21.18 | 30.03 |
| FeO | 9.30 | 11.20 | 48.21 | 13.42 | 10.19 |
| CaO | – | – | – | 1.81 | 0.35 |
| $K_2O$ | 3.28 | 3.52 | – | 0.73 | 0.28 |
| $TiO_2$ | – | – | – | 1.83 | – |

## X-RAY DIFFRACTION RESEARCH

We worked with a TUR M-62 type diffractometer made in Germany – in the University of Miskolc, the Mineralogical Department. The ray source had been $CoK_\alpha$, the filtering had been a thin iron sheet, the speed of goniometer 1°/min. The voltage of X-ray tube 30 kV, the currant intensity had been 20 mA during measuring. Putting the diffractograms that are characteristic of the crystal phases of suevite stones is shown on the Fig. 6. The d value belonging to the summits is the distance between the grated flats in mm, what is characteristic to the identified crystal phase. Identification was carried out by the base of ASTM catalogue.

In this way: d=0,426 nm quartz d=0,334 nm quartz
d=0,404 nm cristobalite d=0,319 nm feldspar

Other values by the catalogue were not identified.

## CONCLUSIONS

Since the component-research by microbougie shows that the $SiO_2$ (53–61%) and $Al_2O_3$ (30–33%) in contents are high, the FeO content is 9–13%, in addition, the inner surface of blisters there is a high, 48,2% FeO settling; outer part of the spongy has 1,8% $TiO_2$ content; consequently, the hitted meteorite was ferrometeorite or stone-ferrometeorite.

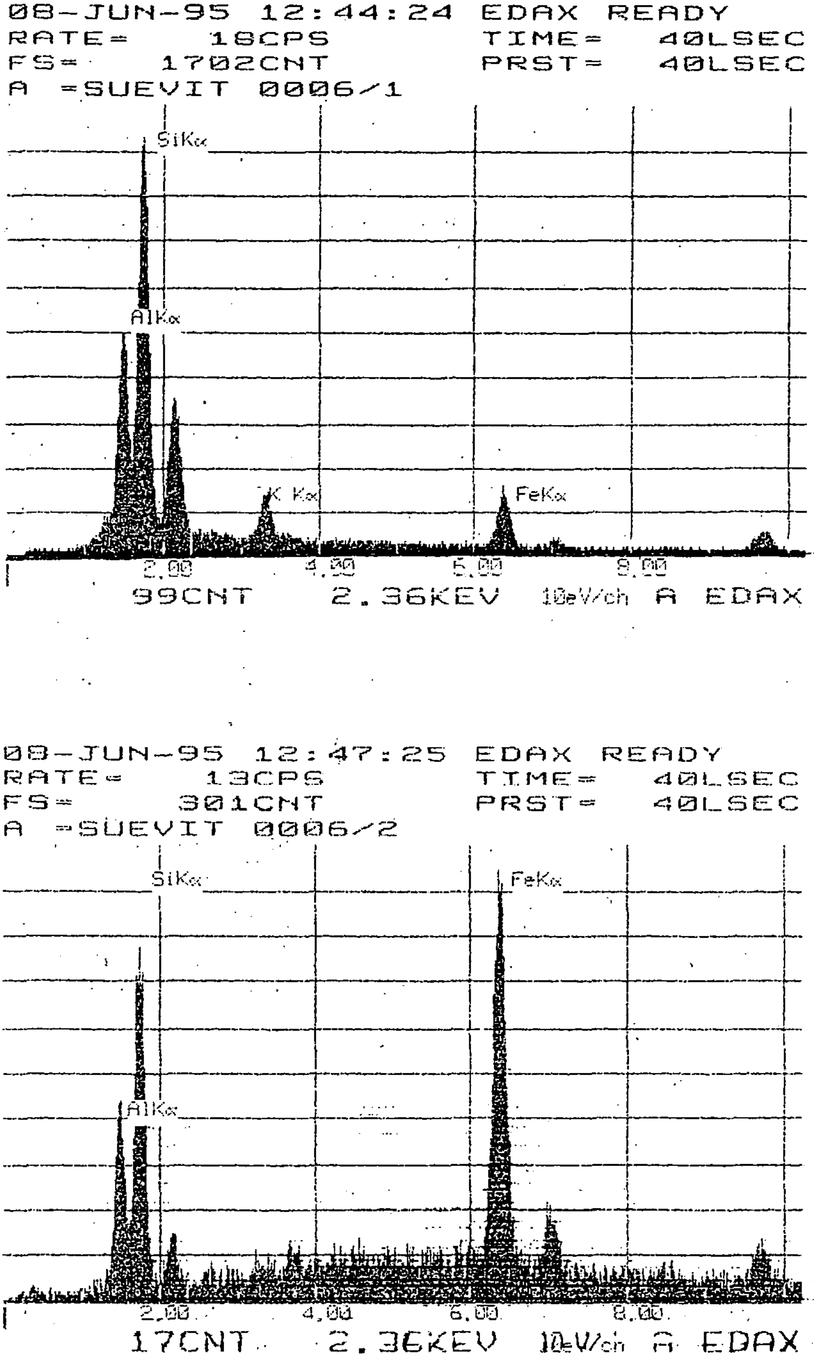


*Fig. 5.* Microbougie spectrums

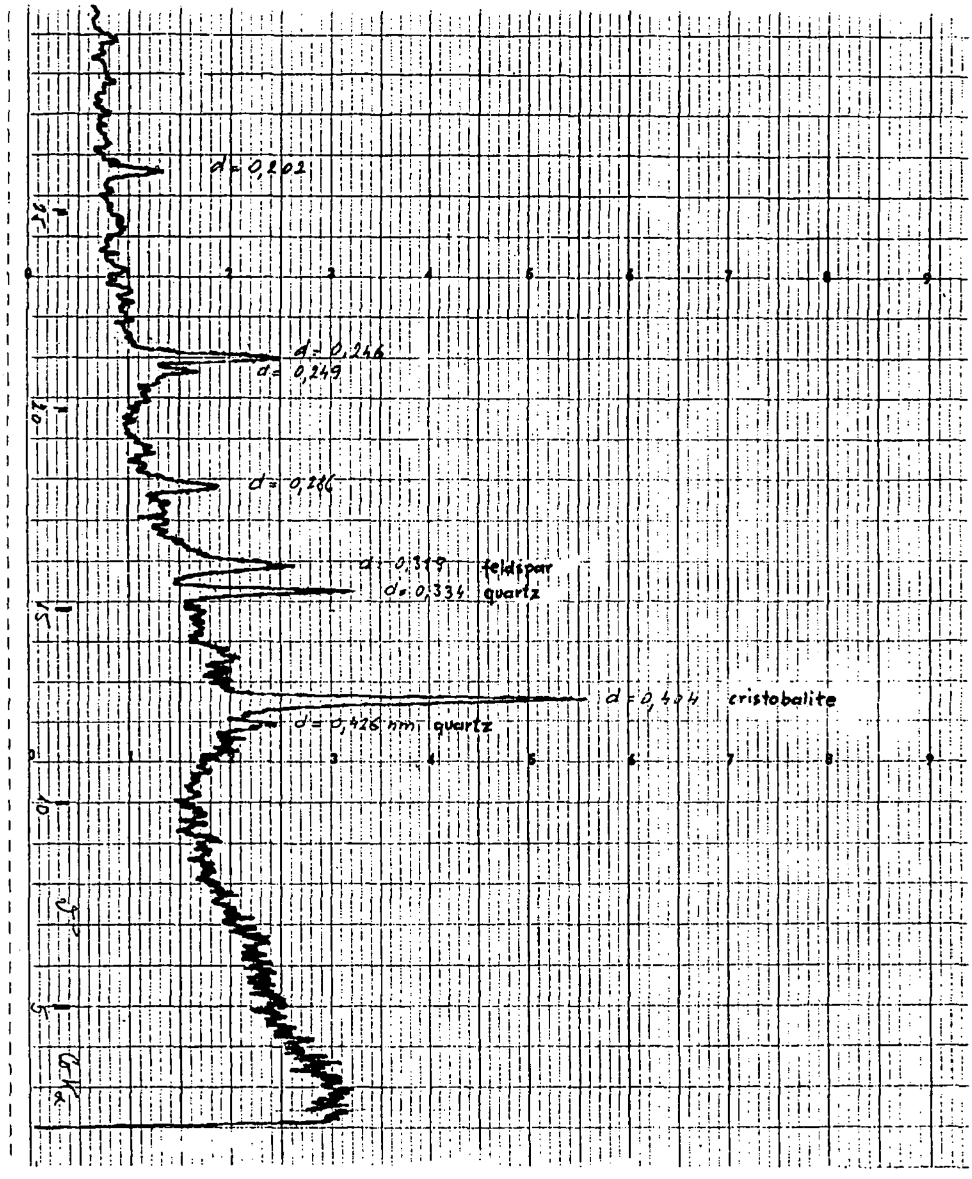


*Fig. 6.* X-ray diffractogram of Bosumtwi suevite

Mineralogically, the suevite samples contain mostly quartz variations and feldspar. X-ray diffractograms detected cristobalite as high temperature $SiO_2$ polymorph, only. No signs of the existence of coesite or stishovite in the investigated samples are observed.

In connection to its hitting the meteorite probably melted and from a part of the shooted rock material tektite came into being. It would be very interesting to compare these results to that of Ivory Coast tektites.

## ACKNOWLEDGEMENTS

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