



QUALITY ASSESSMENT OF IKPESHI WHITE CALCITE DEPOSIT

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Cite this article:

Adakole S., Osaghae S.O.,
Sanni E.B., Mohammed M.M.
(2023). Quality Assessment of
Ikpeshi White Calcite Deposit.
Advanced Journal of Science,
Technology and Engineering
3(1), 75-83. DOI:
10.52589/AJSTE-7CPYH8H7

Manuscript History

Received: 8 Aug 2023

Accepted: 26 Sept 2023

Published: 25 Oct 2023

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ABSTRACT: *The research is to assess the quality of calcite deposit from GOPEX quarries. Samples were collected from five different pits and homogenized; 5 kilograms were gotten and 1 kilogram for laboratory test work and analysis. The sample was crushed to a size of 1400 μ m and was further reduced using ball mill to 1100 μ m. 100gram was riffled out for sieve analysis using set of sieves and mechanical sieve shaker and sieve size of 125 μ m was sampled out for chemical analysis using X-ray Fluorescence Spectrometer, from which measure elements were analyzed. The set of sieves used are 1000 μ m, 710 μ m, 500 μ m, 355 μ m, 250 μ m, 180 μ m, 125 μ m, 90 μ m, 63 μ m, and (-63 μ m), using Gates Gaudin Schumann Method of particles size distribution and Rosin Rammler Method of particles size distribution. The result from sieve analysis shows that the economic liberation size of GOPEX calcite is at sieve number of 180 μ m to 63 μ m, showing the following mid points 6.52% to 7.82%. The equilibrium points from the graph show 50%, which signifies the existence of some if not all of these elements from the chemical analysis in the sample of GOPEX, quarries: Mg, Al, Si, P, S, K, Ca, Ti, V, Cr, Mn, Co, Fe, Ni, Cu, Zn, As, Pb, W, Au, Ag, and Rb with the following mean concentrations to be 0.5217, 1.2314, 2.7804, 0.2573, 0.5684, 0.0000, 61.2238, 0.0000, 0.0000, 0.0000, 0.0015, 0.000, 0.9938, 0.0089, 0.0117, 0.0220, 0.0000, 0.0000, 0.0000, 0.0272, 0.0025 and 0.0015 respectively, with calcium which is the major element in the sample having the following intensities 0.6241 and content of 61.2238. The limestone deposits in these location is rich in calcite which can be useful in production of cement, in agriculture and in chemical/industrial uses.*

KEYWORDS: Quarry, X-Ray Fluorescence, Composition, Calcite, Quality Assessment.



INTRODUCTION

Limestone is a sedimentary rock, composed largely of the minerals calcite and aragonite which are different forms of calcium carbonate and dolomite (Areola et al., 1999). It is often formed from concentration of broken pieces of seashell, and fragments of calcite minerals produced by corals and algae. Limestone can be precipitated either by action of organisms or directly as a result of inorganic processes (Carlson et al., 2008). The term limestone is usually used for rocks containing 50% or more calcium carbonate (Cox et al., 1974), but mineralogical limestone may be regarded as any rock which the carbonate minerals (calcite, CaCO_3 and dolomite, $\text{CaMg}(\text{CO}_3)_2$) exceed the non-carbonate minerals that is calcite and dolomite must be more than 50% in the rock sample (Duncan, 1963; Neendorf et al., 2005).

The type of quarrying industry present in Ikpeshi ranges from manual stone crushing industry to small and medium scale quarrying industries that use heavy machinery for crushing stones. Quarry and quarrying refer to open excavation from which any useful stone is extracted for building, engineering and construction purposes. As a matter of fact, crushing stone generates wide range occupational hazards (Odeyemi, 1976).

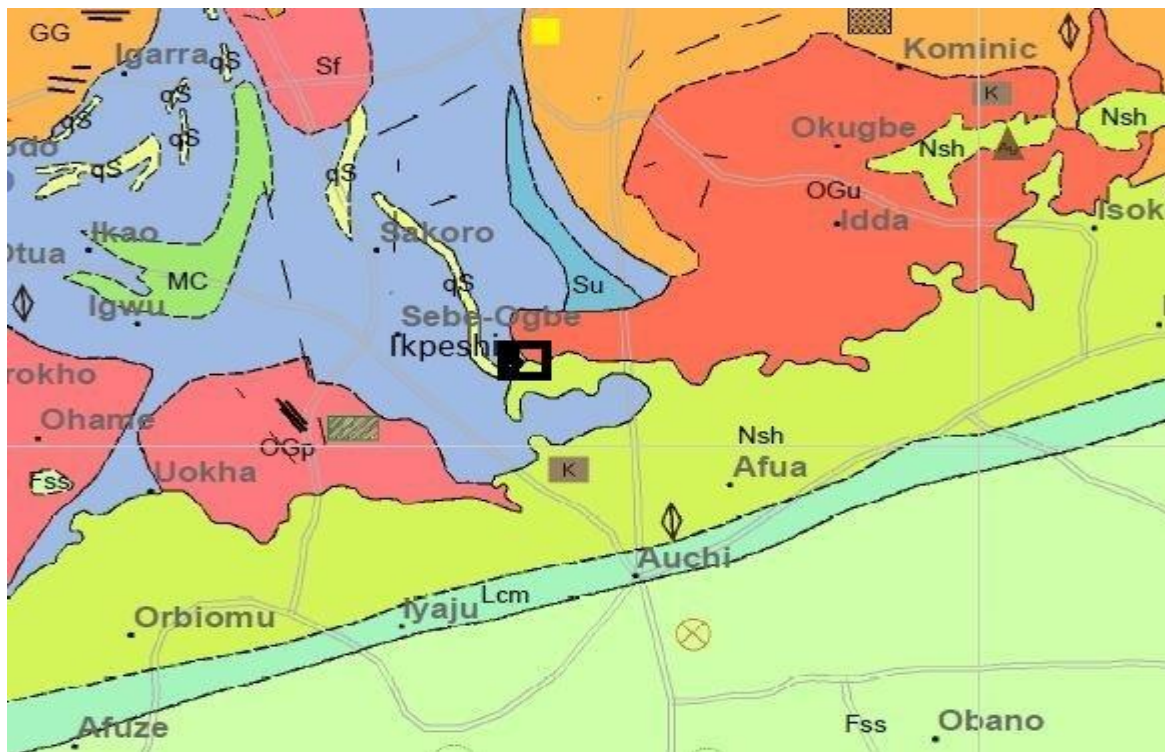
The researchers make an attempt at explaining X-ray fluorescence of the major elemental oxides of limestone in Ikpeshi, Edo state. Several studies were carried out in the marked area and are aimed at providing additional findings on solid mineral potentials of Edo state.

Geology of the Study Area

Ikpeshi and its environment lies within latitudes 7008°N to 7010°N and longitudes 6010°E to 6015°E and is part of Igarra schist belt, southwestern Nigeria. It comprises metasedimentary rocks which include schist, amphibolite, calc-silicate and marble which have been subjected to polyphase deformation and have subsequently been intruded by post-tectonic granitic rocks of Pan-African ($600 \pm 150\text{Ma}$) age. Mineralogically, average modal composition shows that the rocks in the area consist of quartz, k-feldspar, plagioclase, mica, muscovite and calcite as the major minerals while opaque are accessory minerals. More than three phases of deformational episodes have been recognized in the rocks of this area. The first phase was associated with the development of the regional foliation with open, close, tight isoclinal folds, followed by the heterogeneous deformation which gave rise to ductile shear zones, in an extensional tectonics environment. The third phase produces the dominant major folding on an approximately NW-SE axis and the last phase is associated with open folds added to the earlier formed structures. The structural element in the study area shows multidirectional orientations. Rocks in the study area have a general and consistent trend as revealed by rose diagrams and stereographic projection in NNW–SSE, and a few N-S to NE-SW direction which is an indicative of Pre-Pan-African orogeny. The other trends as revealed by the plots which is not prominent, is in E-W and ENE-WSW direction are relics associated with Pre-Pan African orogenic events (Agomuo *et al.*, 2016).

The schist in the study area is foliated in NW-SE direction and some others N-S; there are also occurrences of quartz veins, joints and fractures in the granite body. The Igarra granites intruded the most easterly schist belts in South-Western Nigeria (Turner, 1983). The Igarra region is underlain by rocks of the Precambrian Base-ment Complex and about four major groups have been observed within this area. These are the migmatite-gneiss complex, the metasediments (schists, calc-silicate rock, quartzites, marble, meta-conglomerates) and the

porphyritic older granite which are discordant, non- metamorphosed syenite dyke (Odeyemi, 1976).



LEGEND

- Al River Alluvium
- SDP Sand, clay and swamp Sombreira - Warri Deltaic Plain
- CPs Sand and clay
- Lsr Lignite, claystone and clay
- BAsh Clay, clayey sandstone and shale
- IMsh Clay, shale with limestone
- Fss Sandstone, coal and shale
- LCM Coal, sandstone and shale
- Nsh Shale and mudstone
- OGp Coarse grained granite
- OGu Undifferentiated older granite mainly porphyritic granite
- qS Silicified sheared rocks
- mC Meta - conglomerate biotite, garnet gneiss and schist
- Al Fine grained flaggy quartzite and quartz schist
- Su Undifferentiated schist
- GG Granite gneiss
- Al Porphyroblastic gneiss
- MG Migmatitic granite gneiss
- M Migmatite

Source: Nigerian Geological Survey Agency, 2006



METHODOLOGY

Sampling Collection and Analysis

A total of five (5) samples were collected from different stationary lots of the site. The calcite deposit is excavated to a dump site called a stockpile, and from these stock a sample collector was used to collect samples from different faces of these stockpiles as the excavated deposits are dumped to form a single lot of 10kg.

10kg of the sample was crushed to 5000 μ m in the laboratory using two different jaw crushers and the sample was split into different portions using a sample splitter. The sample was passed through a set of sample splitter which rifled out two different portions. 5kg of the calcite sample was crushed about 5000 μ m and 5kg of the sample (5000 μ m) was further crushed using another secondary crusher with smaller size to reduced it 3000 μ m. 5kg of the calcite sample with size 3000 μ m was feed into a ball mill to grind it to pass through a sieve 1100 μ m. The calcite sample was fed into the ball mill and was set into rotations for ten minutes until all the calcite sizes were below 1100 μ m. 1 kg of the calcite sample was rifled out and a sub sample (100g) was rifled out of the 1kg. The sub-sample was placed into a set sieve and placed on a screen deck and ran the deck on the Ro-Tap machine for 10 minutes duration on sets of sieves of 1000 μ m, 710 μ m, 50 μ m, 355 μ m, 250 μ m, 180 μ m, 125 μ m, 90 μ m, 63 μ m and -63 μ m standard sieves sizes. And the recorded weight of the particle retained on each sieve size was taken.

X-ray Fluorescence Spectrometer operations, sample preparation: For non-homogeneous samples, samples will be pulverized to fine homogenous size and then pelletized. Sample Testing Start, initialization (calibration), using pure silver standard, selected the working curve according to the sample, test sample, output to Excel, and End.

RESULTS

Table 1: Sieve Analysis Results

SIEVE SIZE (μm)	MASS RETAIN (g)	MASS PASSING (g)	CUMULATIVE MASS RETAINED (g)	CUMULATIVE MASS RETAINED (%)	CUMULATIVE MASS PASSING (%)
1000	14.33	84.50	14.33	14.50	85.50
-1000+710	0.39	84.11	14.72	14.89	85.11
-710 + 500	0.45	83.66	15.17	15.35	84.65
-500 +355	0.44	83.22	15.61	15.79	84.21
-355+ 250	1.01	82.21	16.62	16.82	83.18
-250 + 180	36.02	46.19	52.64	53.26	46.74
-180 + 125	0.03	46.16	52.67	53.29	46.71
-125 + 90	0.31	45.85	52.98	53.61	46.39
-90 +63	0.30	45.55	53.28	53.91	46.09
PAN(-63)	45.55	0.00	98.83	100.00	0.00

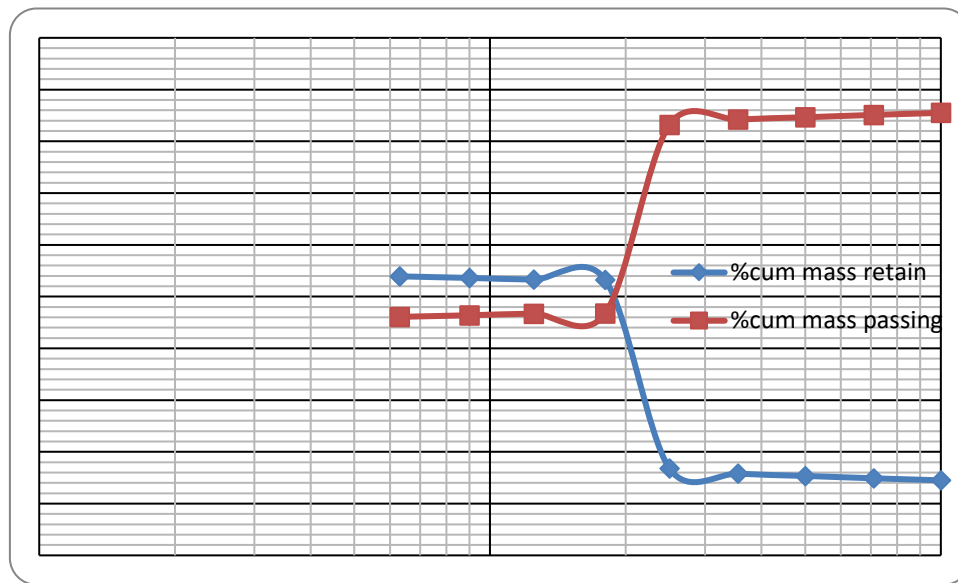


Figure 1: Showing the graph of %cumulative mass retained and %cumulative mass passing against sieve sizes

Table 2: Gates Gaudin Schumann Method of Particles Size Distribution Result

SIEVE SIZE (μm) (x)	MASS PASSING (P) (%)	$\frac{P}{100}$	$\text{Log}\left(\frac{P}{100}\right)$	$\text{Log}(x)$
1000	85.50	0.8550	-0.0680	3.0000
-1000+710	85.11	0.8511	-0.0700	2.8513
-710 + 500	84.65	0.8465	-0.0724	2.6990
-500 +355	84.21	0.8421	-0.0746	2.5502
-355+ 250	83.18	0.8318	-0.0800	2.3979
-250 + 180	46.74	0.4674	-0.3303	2.2553
-180 + 125	46.71	0.4671	-0.3306	2.0969
-125 + 90	46.39	0.4639	-0.3336	1.9542
-90 +63	46.09	0.4609	-0.3364	1.7993
PAN(-63)	0.00	0.0000	0.0000	0.0000

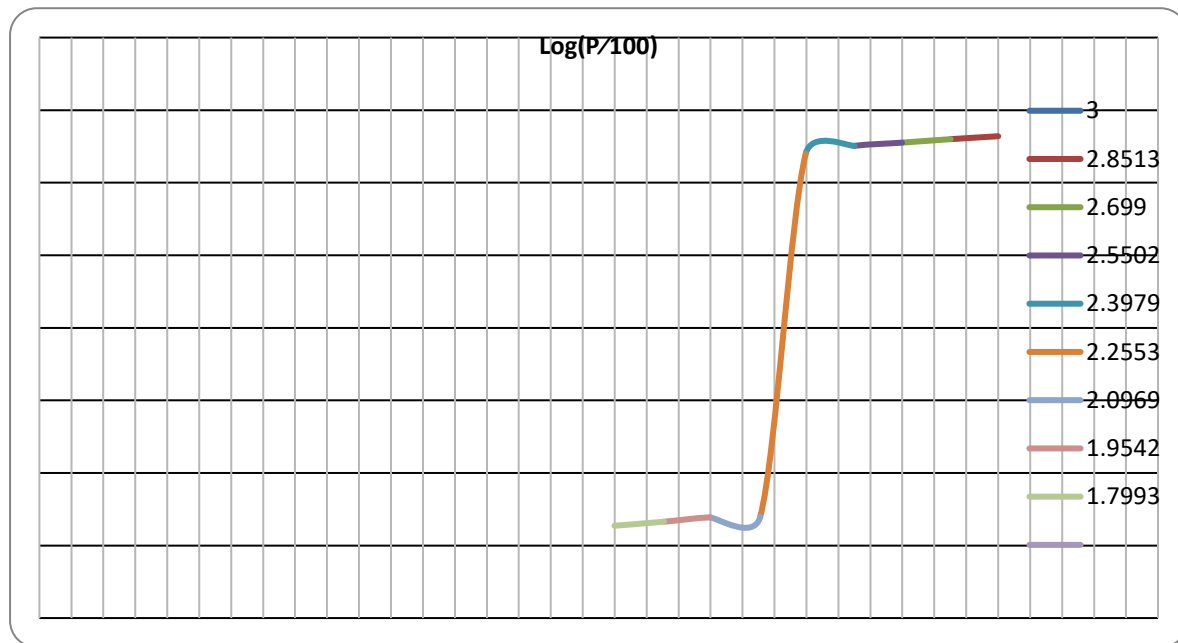


Figure 2: Showing the graph of $\text{Log}\left(\frac{P}{100}\right)$ on the vertical axis against $\log(x)$ on the horizontal axis using Gates Gaudin Schumann method

Table 3: Rosin Rammler Method of Particles Size Distribution

SIEVE SIZE (μm) (x)	MASS RETAIN(R ($\frac{100}{R}$) (%))	$\ln\left(\frac{100}{R}\right)$	$\text{Log}\left(\ln\frac{100}{R}\right)$	$\text{Log}(X)$	
1000	14.50	6.8966	1.9310	0.2858	3.0000
-1000+710	14.89	6.7159	1.9045	0.2798	2.8513
-710 + 500	15.35	6.5147	1.8172	0.2594	2.6990
-500 +355	15.79	6.3331	1.8458	0.2662	2.5502
-355+ 250	16.82	5.9453	1.7826	0.2511	2.3979
-250 + 180	53.26	1.8776	0.6300	-0.2007	2.2553
-180 + 125	53.29	1.8765	0.6294	-0.2011	2.0969
-125 + 90	53.61	1.8653	0.6234	-0.2052	1.9542
-90 +63	53.91	1.8549	0.6178	-0.2092	1.7993
PAN(-63)	100.00	1.0000	0.0000	0.0000	0.0000

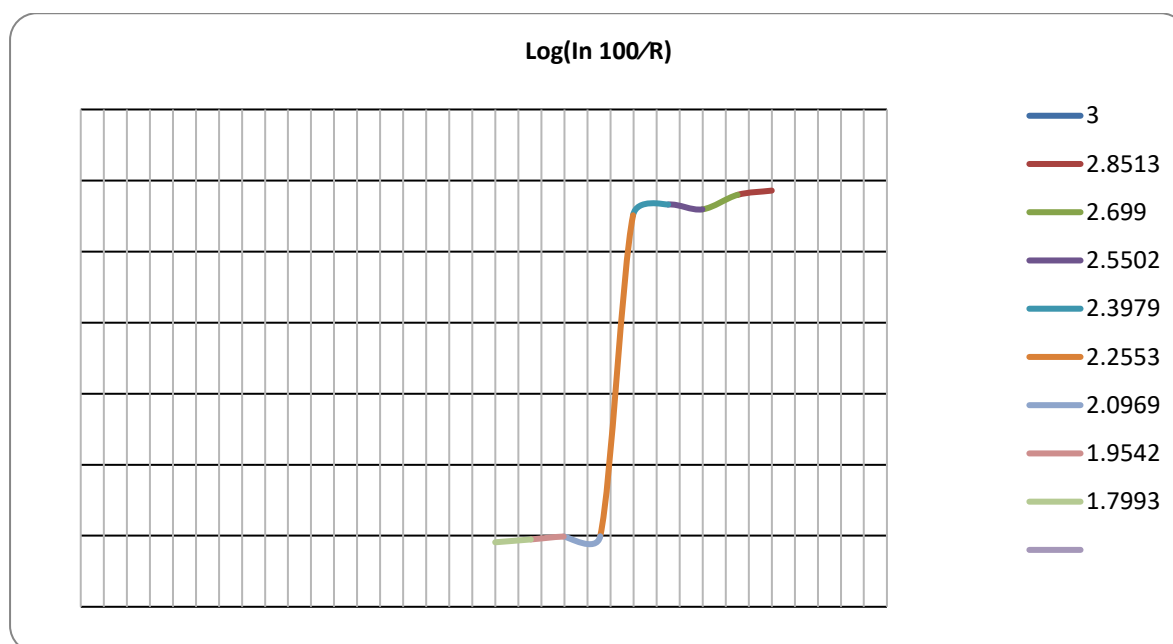


Figure 3: Showing the graph of $\text{Log}(\ln \frac{100}{R})$ on the vertical axis against $\log(x)$ on the horizontal axis using Rosin Rammler method

Table 4: X-ray Fluorescence Spectrometer (Chemical) Analysis Result

SAMPLE	CALCITE	
Voltage(KV)	40	
Current(μA)	350	
Element	Intensity	Content
Magnesium(Mg)	0.0004	0.5217
Aluminum(Al)	0.0038	1.2314
Silicon(Si)	0.0281	2.7804
Phosphorous(P)	0.0055	0.2573
Sulphur(S)	0.0076	0.5684
Potassium(K)	0.0000	0.0000
Calcium(Ca)	0.6241	61.2238
Titanium(Ti)	0.0001	0.0000
Vanadium(V)	0.0000	0.0000
Chromium(Cr)	0.0000	0.0000
Manganese(Mn)	0.0001	0.0015
Cobalt(Co)	0.0001	0.0007
Iron(Fe)	0.0096	0.9938
Nickel(Ni)	0.0002	0.0089
Copper(Cu)	0.0006	0.0117



Zinc(Zn)	0.0007	0.0220
Arsenic(As)	0.0000	0.0000
Lead(Pb)	0.0000	0.0000
Tungsten(W)	0.0000	0.0000
Gold(Au)	0.0000	0.0272
Silver(Ag)	0.0001	0.0025
Rubidium(Rb)	0.0004	0.0015

DISCUSSION

Table 1 shows a summary of sieve analysis results on Ikpeshe calcite deposits. In the table, it was discovered that the economic liberation size begins at sieve 180 μ m to 63 μ m because most of the particles are retained on these sieges, but the mid points are 6.52% to 7.82%. This value is obtained from subtracting % cumulative mass pass from % cumulative mass retain from sieve 180 μ m to 63 μ m. The major component in the samples is calcium carbonate. The result shows that Ca is the most abundant followed by Si, Al, Fe and S and others.

Calcite with a chemical formula of CaCO₃, the chemical analysis shows that the calcite intensity is 0.6241, with content of 61.2238, and other elements as shown in table 4 above. This shows that the economic liberation size is a sieve 180 μ m to 63 μ m, showing the following mid-points 6.52%, and the equilibrium points from the graph showing 50%. These calcite deposits have a good particle distribution curve with a mid-point looking more accurate. From the chemical analysis, it shows some of these chemical elements: Mg, Al, Si, P, S, K, Ca, Ti, V, Cr, Mn, Co, Fe, Ni, Cu, Zn, As, Pb, W, Au, Ag, and Rb with the following calcium which is the major element of the sample.

Based on the economic importance, the rock deposits of the Ikpeshe study area can be used for Portland cement with less than 2% Mg, 0.5% total alkalies and CaCO₃ 61.2238%. Even as low as 69.75% CaCO₃ content had been used in Ash Grove cement company in Nebraska, U.S.A. (Wheeler, 1999). Also based on Duncan's (1963) recommendation for rock deposit use in the production of lime, requiring phosphorus at trace level and acceptable lower grades of less than 98% CaCO₃, the rock deposits in this study area meet this requirement.

The deposit in the location is good for concrete aggregate and road base. Whereas the deposit in these locations may not find relevance in glass manufacture, refractories and chemical production, sugar refining and soda ash manufacture all because of the high purity demand of the CaCO₃ content this should not be below 98% (Penuel et al., 2015).

CONCLUSION

The grade of limestone obtained in the Ikpeshe study area can be harnessed for Portland cement production since the percentage carbonate content is above average. It can be used as dimension stones and for ceramic production, used in putty making, sealing, vinyl floor covering, carpet backing, adhesive and asphaltic products. They can serve as a good aggregate in cement (British Standard Institute, 1983). The findings reveal the order thus Ca > Si > Al > Fe > others,



in the sample locations and the composition shows CaCO₃ content of calcite as 61.2238 which is the most abundance.

Acknowledgement

We, the researchers, appreciate the students of the Geological Technology Department, School of Applied Sciences, Auchi Polytechnic, Auchi, Edo, Nigeria who helped us to acquire samples for analysis, processing and as well as interpretation of the processed data. Their hard work and dedication will always be remembered.

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