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***JERT*- Mission Statement**

The Journal of Educational Research and Technology (JERT) is a peer- reviewed journal engaged in the publication of professional educational research with emphasis on educational technology, management information technology, professional development, educational enrichment research, academic and administrative information systems, information sciences, management information consulting, advertisements, academic collegiate conferences, and community education development summits to show the advantages and the broad range of possibilities that education, research and technology can offer in the educational and the world community. The journal is equally engaged in organizing and advising on conferences, workshops and seminars on invitation for publishing and presentation of research papers and original manuscripts that promote further research and knowledge in the humanities and the sciences in the USA, Africa and the world at large. The *JERT* is scheduled to be published three times yearly: January, May and September.

JERT Editorial Policies and Contributions

1. ***The JERT*** editors will consider manuscripts that are organized in accordance with the Mission, Journal Publication, Educational Technology, Management Information Technology, Professional Development, Educational Enrichment Research, Academic and Administrative Information Systems, Information Sciences, Management Information Consulting, Advertisements, Academic Collegiate Conferences, and Community Education Development Summits**.** Please feel free to contact us at (469) 534- 2720 or E-mail: jesin57@gmail.com.
2. Personal and professional opinions, ideas, recommendations articulated in the ***(JERT)*** do not necessary reflect the views of the Editors.
3. All manuscripts must be accompanied by well-synthesized **Preamble** or abstract of approximately 100-200 Words.
4. Manuscripts must not be less than ten (10) pages and not exceed twenty (20) pages in length, and must have outstanding and innovative educational, research, and technology features.
5. Manuscripts must be typed double-spaced in Microsoft Word version 2003 or 2007 and printed on 20 pound papers (8.5" x 11").
6. ***JERT*** will not consider politically goaded manuscripts for publication.

7. The author of the research manuscript must submit two original copies. Each copy should contain a cover page with the name of author, topic/title. The essay proper should not have any author's name or indication of origin, except for the topic/subject at the top of the paper. This is for blind reviewing.

8. All research manuscripts must be submitted with 15-20 cited-references, and 5-10 non-cited references, double-spaced, and arranged in alphabetical order.

9. Footnotes are strongly discourages but when used should be typed double-spaced, and on a separate page.

10. The basic style of writing is the American Psychological Association (APA), though room will be given for the Modern Languages Association MLA where literature and languages are involved.

11. Papers received shall be acknowledged and those accepted for publication will be notified and instructions given as to the status of the paper (accepted for publication, accepted contingent on specific revisions, and the time line for all revisions.

12. Copyright must be authorized and surrendered to JERT, and expressed usage can only be authorized by the Board of Trustees and JERT Editorial Council.

THANK YOU FOR YOUR PATRONAGE

Preamble

The Editorial Council is very delighted to publish Volume IV of the Journal of Educational Research and Technology (JERT). The production of Volume IV could have not possible without the persistent tireless efforts of the JERT Editorial Council and the priceless support of Professor of Emmanuel N. Ngwang, JERT Chief Editor and Professor Anne-Christine Hoff, Principal Editor and all well-wishers.

Professor Joseph O. Esin, the Chief Publishing Editor of *The Journal of Educational Research and Technology (JERT)*, holds a Bachelor of Science in Biology from Saint Louis University, Saint Louis, Missouri; a Master of Arts in Religious Studies with emphasis on Moral Theology from the Society of Jesus College of Divinity, Saint Louis, Missouri; and a Doctorate in Computer Education from the United States International University, San Diego, California. The State of California awarded him a Life-time Collegiate Instructor's Credential in 1989, and in 1996, the United States Department of Justice approved and conferred on him the honor of "Outstanding Professor of Research" in recognition of his contributions to academic excellence.

He met the selection criteria for inclusion in the 1992-93, 1994-95, and 1996-97 editions of Who's Who in American Education for his outstanding academic leadership in management information technology. Furthermore, he met the selection criteria for inclusion in the 1993-94 edition of the Directory of International Biography, Cambridge, England, for his distinguished professional service in academic computing technology. A Professor of Computer Information Technology from 1988-2000, a Director of Higher Education Accreditation operations in accordance with the guidelines set forth by the COMMISSION ON COLLEGES from 1991- 2000. He was appointed Associate Dean of Academic Affairs and a Deputy Provost at Paul Quinn College, Dallas, Texas, from 1997-2000. He is currently a professor of computer information systems at Jarvis Christian College, Hawkins, Texas, USA, a visiting Professor of Research at the University at Calabar, Nigeria and a Research Associate at the Botanical Research Institute of Texas (BRIT) USA. Professor Esin has published several professional journal articles including "High Level of Teachers' Apprehension (HLTA): About the use of Computers in the Educational Process." Journal of Educational Media & Library Science (JEMLS-1991); "Computer Literacy for Teachers: The Role of Computer Technology in the Educational Process." (1992-JEMLS); "Faculty Development: Effective use of Applications Software in the Classroom for instruction." (1993-JEMLS); "Strategies for Developing and

Implementing Academic Computing in Colleges and Universities." (1994-JEMLS); "Strategic Planning for Computer Integration in Higher Education through the Year 2000." (1994-JEMLS); "The Challenge of Networking Technologies." (1995-JEMLS); "The Design and Use of Instructional Technology in Schools, Colleges and Universities." (1997-JEMLS); "Decay of the Nigerian Education System." Journal of Educational Research and Technology (JERT-2013); "The Emerging Impact of Information Technology on Education and the Community." (2013-JERT); "Balanced Salary Structure for Academic Professors and Allied Educators as a Pathway to Quality Education." (2014-JERT) and "The Discovery of Computer Information Technology is an avenue for Educational Transformation in a Changing Society of Today and Tomorrow." International Organization of Scientific Research Journal of Engineering. (2014-IOSR-JEN).

He served as a member of Doctoral Dissertation Committee at Southern Methodist University, Dallas, Texas (1998-2000), and Jackson State University, Jackson, Mississippi (2010-2011). He is the author of The Power of Endurance (2008); The Evolution of Instructional Technology (2011); The Messianic View of the Kingdom of God (2011) and Global Education Reform (2013). Professor Esin's current research emphasis is on The Fundamentals of Computer Information Technology in a connected society.

Word of Caution

In order to achieve what is possible, you must attempt the impossible.

Professor Joseph O. Esin,
JERT-Chief Publishing Editor

Professor Emmanuel N. Ngwang, the Chief Editor of *The Journal of Educational Research and Technology (JERT),* is a 1986 graduate of Oklahoma State University with a Ph.D. in American Literature and presently a Professor of English and Foreign Languages at Jarvis Christian College. Before joining the faculty of Jarvis Christian College, he taught in several universities since 1982: a Graduate Associate at Oklahoma State University (1982-1987); University of Yaoundé, Cameroon (1987-1997); Kentucky State University (1997-2003); Mississippi Valley State University from (2003-2010); and at Claflin University (2010-2012). He has edited two books on criminal justice by Peter Nwankwo: *Criminological and Criminal Justice Systems of the World: A Comparative Perspective* (2011) and *Criminal Justice in the Pre-Colonial, Colonial, and Post-Colonial Eras: Am Application of the Colonial Model to changes in the severity of punishment in the Nigerian Law* (2010).

In addition, Professor Ngwang has published and presented research papers on postcolonial, African, and modern dramatic literature and Feminism. Some of his recent publications include "Education as Female (Dis) Empowerment in Anne Tanyi-Tangs *Arrah"* in *The Atlantic Review of Feminist Studies Quarterly (*2012)*.* "Arrah's Existential Dilemma: A Study of Anne Tanyi-Tang's *Arrah* in *Cameroon Literature in English: Critical Essays* (2010), "Spaces, Gender, and Healing in Alice Walker's *The Color Purple* and Mariama Ba's *So Long a Letter*" in *New Urges in Postcolonial Literature: Widening Horizons* (2009), "Re-Configuration of Colonialism or the Negation of the Self in Postcolonial Cameroon in Bole Butake's Plays in *Reconceiving Post colonialism: Visions and Revisions* (2009), Buchi Emecheta's *Destination Biafra*: A Feminist (Re-)Writing of the Nigerian Civil War in *Journal of African Literature: International Research on African literature and Culture (JAL:IRCALC)* (2008)*, "*In Search of Cultural Identity or a Futile Search for Anchor: Africa in Selected African American Literary Work*s*" *Identities and Voices. ALIZES (TRADE WINDS 2007)* "Literature as Politics: Revisiting Bole Butake's *Lake God and Other Plays*" in *The Literary Griot: International Journal of African-World Expressive Culture (2002*)*,* and "Female Empowerment and Political Change: A Study of Bole Butake's *Lake God, The Survivors,* and *And Palm Wine Will Flow"* in *ALIZE (TRADE WINDS): A Journal of English Studies (2004)* (University of La Reunion, France).

Professor Ngwang has also been a recipient of prestigious awards in recognition of his academic and research endeavors: 2013-2014 Faculty Scholar Award in Recognition of His

Outstanding Research and Publication Work conferred by the Faculty Governance Senate of

Jarvis Christian College, Hawkins, Texas; the *2004 Humanities Teacher of the Year Award* from the Mississippi Humanities Council, Jackson Mississippi; *2002-2003 Excellence in Scholarship and Creative Activities*, College of Arts and Sciences, Kentucky State University; and two-time nomination to the *Who's Who Among America's Teacher* (2001 and 2002 respectively), Educational Communications, Inc.; Lake Forest, Illinois.

A word to think about:

We are remembered by what we leave behind

For what we leave behind tells the true story of who we

were And how and for what we lived.

Professor Emmanuel N. Ngwang
JERT-Chief Editor

Introduction

The JERT Editorial Board is again delighted to present to you Volume 4 of the *Journal of Educational Research and Technology* (*JERT)*, which takes a swift turn in the area of technological research. The inclination towards expulsion of African, earth sciences and integration of information technology in the articles presented shows the determination of the Editorial Board to include and embrace all areas of research, especially the research the shares knowledge of our homeland and mother Earth.

This Volume is dignified by the continuous efforts of Professor Joseph O. Esin to bring the integration of technology into the educational process, instruction, every learning and business environment especially in today's world of globalization and cyber gyration. In Article 1, Integration of Information Technology in Education, Instruction and Learning in a Connected Society, Professor Esin takes the reader back to the domain of the classroom instruction, learning endeavors, the invasion and role of information technology in education and computer literacy. Professor Esin continues to insist on the reality of the overpowering nature of instructional technology, which is here to stay and eventually make instruction and learning less stressful. His research has revealed that today's "professors, allied educators, students and consumers are using technology to prepare, educate, manage and deliver instruction, publish and disseminate information that was previously too expensive and almost impossible to produce and distribute to the general public." He goes further to declare emphatically that, "the era of integrated technology is sponsoring the democratization of the production and flow of information to the educational community and the masses." This research reveals the incontestable value of educational technology and the need for all— both in the educational world and the public spheres—to welcome and embrace this initiative wholeheartedly to "unlock students' academic potential" and global communications.

This article particularly resonates with the "Y" and Millennium generations who are much more attached and atoned to technology in all aspects of their lives, including academic advancement. This article tends to argue for them and support their determination to be computer savvy, because that is the way of today's word and nobody wants to be left behind. This approach will definitely revolutionize education and move it from the constraints and limitations of the classroom to the outside world academic projects and class assignments can be done from the ease of a sitting room, in the pew of a church or the arm chair of the airplane. Professor Esin also addresses the Best Practices of tailoring educational delivery to the learning styles of the students so as to get the best, "to trigger students' critical thinking ability, productive outcomes and lasting solution to learning processes." He particularly draws his conclusions from a set of questionnaire he administered to college students who indeed are the core and cardinal partners of his research initiative.

Article 2 opens up with the current, disturbing, yet aggressive research on immigration and identity. Appropriately entitled The Lost Generation or the Peril of Belonging: A Study of Africans in Exile, Professor Emmanuel N. Ngwang's article takes a bold review of the dilemma and frustrations incumbent on African immigration into the USA. This article takes a position different from those that have often glorified immigration and the attendant benefits thereof. From Professor Ngwang's research, personal experience and interviews, the article depicts the trauma of exile as those on voluntary or forced immigration face the almost insurmountable journey of searching for peace and a successful life in a society that seems, on the outside, very welcoming, but in the inside very unreceptive to the "African" foreigners. Professor Ngwang documents instances of broken families, murders and tempted murders, accusations and victimization which these Africans have receive from vast segments of American communities inclusive of African Americans and white Americans who had migrated before them and the

Americans who consider the immigrants a continuous threat to their economy and freedom. Professor Ngwang's research gives an interesting perspective on immigration and tempts to advance a solution to the continuous conflict that tends to define and fuel the relation between African-born of African Americans and the traditional African-born Americans. The article also diagnoses the problems and issues that aggravate and intensify these feelings of loneliness, disconnectedness, and "loss," which surface in many encounters between the "the New Generation African American" and the African Americans where complexes have determined the fate of each group. The answer seems to be in the continuous lack of trust created by the receiving nation and the betrayals emerging from marital relationships and the continuous struggle among natives and colleagues to betray each other in order to move forward to the attainment of the American Dream.

Professor Ngwang's article also attempts to find solutions and propose suggestions to the solutions of those factors that are catalytic to the situation. The onus of redress lies on the incoming immigrants (strangers), who arrive with pumped up and faulty, fantastical misconceptions about the ease attendant in obtaining the American Dream in the United States, a promised land flowing of milk and honey. They envision the United States as a land of challenges where anything is possible and everything is impossible. Such a realistic approach will take away the veneer of sobriety and luxury that has tended to embroider the USA Hollywood pictures so that the real pictures of the hard knocks will become available. Secondly, there is an attempt to ask for a more humanistic and welcoming attitude on the part of the Native African Americans who tend to receive and operate with the immigrant Africans purely on artificial and suspicious terms. Globalization is a give and take and this calls for a certain measure of acceptance, understanding, tolerance, faith and collaboration from both parties.

In Article 3: Relative Age and Paleo Environment of Sandstone – conglomerate Deposits in the Northeastern Niger Delta, Nigeria, Dr. David Inyang and Professor L. C. Amajor of the Department of Geology in the University of Calabar and Port Harcourt respectively, and Dr. M. U. Udoh, a South-Sea Petroleum Consultant affiliated with both universities lead the reader into a bold attempt to determine the relative age and paleo environment of Sandstone-Conglomerate deposits in the Northeastern Niger Delta of Nigeria. This collaborative study, sponsored by the University of Calabar, Nigeria in collaboration with the South-Sea Petroleum Consultants, uses sophisticated cutting-edge technology to analyze and deduce the age of the sand-conglomerate deposits outcropping in the northeastern region of the Niger Delta. This scientific and intellectual exercise reveals and thereby confirms previous suspicions studies of the area that though the contiguous sedimentary units of the area studies were deposited in neritic environments. Based on the result of this study, it is worth noting that the sandstone- conglomerate bodies are of fluvial/continental plain origin. Furthermore, their research also found that the palynomorphs found in the sandstone-conglomerate units were mostly forest, savanna, and montane species asserting that these deposits are continental/fluvial plain in origin. Of great significance to the lay person is the vegetation or horticultural significance of the studies which revealed the level of salt and acidity and how these could affect vegetation and farming.

The overall significance in this study is the determination of the underlying bedrocks of the areas and their ultimate ramification of an implication for mineral resources, horticulture, settlement, natural disasters and mitigation as all these factors intertwine and depend very much on the solidity and chemical composition of the soil and rocks that underlie the area of study.

Article 4: Pebble Morphometric Analysis of Awi Formation in Calabar Flank, Nigeria" presents the studies and findings of Drs. Asukwo E. Itam, David O. Inyang, Etie B. Akpan and

AWI FORMATION

PEBBLE MORPHOMETRIC ANALYSIS OF AWI FORMATION IN CALABAR FLANK, NIGERIA

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Abstract

Pebble morphometric analysis was carried out on the conglomerate beds of Awi Formation of the Calabar Flank to analyze the paleodepositional environment. A total of 360 unweathered quartz pebbles were collected and their Long (L), Intermediate (I) and Short (S) axes were measured with values ranging between 2.14cm and 2.69cm, 1.60cm and 2.11cm and 1.19cm and 1.48cm respectively. The values of pebbles morphometric indices computed were Flatness Ratio (FR=0.52-0.59) Coefficient of Flatness Ratio (CFR= 52%-59%), Elongation Ratio (ER= 0.72-0.83), Maximum Projection Sphericity Index (MPSI= 0.70-.0.72) and Oblate-Prolate Index (OPI = -1.23-2.31). Roundness from Sames Chart were estimated and ranged from 27% to 37%. The mean values of the calculated indices show 0.57, 57%, 0.76, 0.75 and 0.80 for FR, CFR, ER, MPSI and OPI indices. These values occur above the lower empirical limits that distinguish high energy beach from low energy fluvial pebbles. Roundness values of 35% angular to sub-angular pebbles inferred short distance of transportation .The forms predominant were of fluvial: Compact Bladed (80%CB), over a beach Bladed (20% B).The various scattered plots of CFR against MPSI,

MPSI vs. OPI and Roundness against ER indicate the environment of deposition of Awi Formation to be fluvial.

Introduction

Awi Formation is the oldest sedimentary unit in the Calabar Flank. The Formation is about 500m thick and consists dominantly of conglomerates and sandstones with minor siltstones, mudstones, shales and some carbonaceous materials in a cyclic fining upward unit that sits non- conformably on basement complex of the Oban Massif (Nyong, 1995) in the southeastern Nigeria (Figure 1). The Formation is well exposed along Calabar - Ikom road in Cross River in Nigeria. The study area is documented -from page 4.

The use of pebbles morphometry to analyze this Formation involved use of indices such as Flatness Ratio (FR), Coefficient of Flatness Ratio (CFR), Elongation Ratio (ER), Maximum Projection Sphericity Index (MPSI) and Oblate- Prolate Index (OPI) with the visual estimation of pebble roundness using roundness chart of Sames (1966) to evaluate paleodepositional environment of Awi Formation. The result obtained will enhance comparison with results of its equivalence in other localities.

Geologic background

The Calabar Flank is an epirogenic sedimentary basin in southeastern Nigeria (Murat, 1972). The basin, according to Nyong (1995), is bounded to the southern rim by Oban Massif in the north. The Calabar hinge line separates the basin from Niger Delta basin in the south, and the Ikpe platform and Cameroon volcanic trend delineate it in the west and east respectively. The origin of this basin is associated with the opening of the South Atlantic in the Mesozoic era when the South American plate drifted away from African plate. The major tectonic elements operating within the basin include the Ikang Trough (graben structure) and Ituk High (horst) which were mobile depression and stable mobile submarine ridge, respectively that initiated sedimentary distribution phases (Murat, 1972 and Nyong, 1995).

The stratigraphic succession in the Calabar Flank is shown in table 1. Sediment thickness is over 3500m with the onlap (or featheredge) of the outcropping units north of Calabar, along the fringes of the Oban Massif basement complex. The Formations are best exposed along Calabar–Ikom road and a succession consists of five (5) Cretaceous and a Tertary Lithostratigraphic units. Awi Formation is the oldest basal unit and sits non-conformably on the basement complex of Oban Massif. The Formation is Aptian in Age (Adeleye & Fayose 1978). This is overlain by Mfamosing Limestone of Middle- Upper- Albian age (Petters 1982) which indicates the first marine transgression into the basin. This in turn was succeeded by Late Albian- Cenomanian to Turonian, Ekenkpon Shale Subsidence on the faulted blocks of horst and graben allowing wide spread deposition of shales with minor marl and mudstone intercalation. The New Netim Marl of Coniacian (Nyong, 1995) in age, succeeded the shale. The Santonian period was marked by a major unconformity in Nigeria. Nkporo Shale of Late Campanianto Early Maastrichtian (Edet and Nyong 1994) capped marine transgression and Mesozoic sedimentation in Calabar Flank. The Tertiary continental sands and gravel of Benin Formation completes the sedimentation episode in the basin (Fig. 1).

Lithostratigraphy of Awi Formation

The pebbles samples under investigation from Awi Formation are located in Calabar Flank. The Awi Formation is underlain non-conformably by the Pre- Cambrian rocks of Oban Massif in southeastern Nigeria. The Pre- Cambrian rocks in the mapped section include schist and gneiss, which are intruded by pegmatite and granites and granodiorite in some places.

The Awi Formation consists of cyclic sequences of conglomerate, sandstone, siltstone, claystone, mudstone and carbonaceous shale. The conglomerate is matrix supported and consists predominantly of quartz pebbles (Figure 3). The sandstone are medium to coarse grained, and moderately to poorly sorted with quartz and feldspars (Figure 4). The grains are angular to sub-

angular, showing short distance of transportation. The sandstone and the shale beds lack marine fossils and the presence of plants impressions remains on the shale coaly beds suggesting fluvio-deltaic settings (Adeleye and Fayose ,1978).

The sedimentary structures present include small folded sandstone beds, listric faults, cross bedded sandstone and some lenticular bed forms. The cross beds have a gentle dip.

Material and Method

A total of three hundred and sixty (360) quartz pebbles from ten (10) different locations (Road cuts, stream channels and local quarries sites) were sampled. The study area is located within longitude 008 17 12" and 008 18 32" and latitude 05 12 30′ and 05 14 02′ (Figure 3). Using Vernier Caliper based on Krumbein (1941), the Pebble Morphometric measurement method of the Long (L), Intermediate (I) and Short (S) axes of pebbles were computed with their indicial values, forms and their roundness were evaluated visually based on Sames (1966). The mean values of morphometric parameters were calculated (Table 2)

Results snd Interpretations

The pebble suites range from 2.14cm to 2.69cm, 1.6cm to 2.11cm, and 1.19cm to 1.48cm in values of the Long (L) , Intermediate (I), Short (S) axes respectively as, while their average values are 2.41cm,1.83cm and 1.34cm respectively .Flatness ratio (FR) ranging from 0.52 to 0.59 with a mean of 0.57 ;Flatness index (FI) varies from 52%to 59% with an average value of 57% and Elongation ratio (ER) varies from 0,72 to 0.82, mean of 0.76 .The Maximum projection sphericity index (MPSI) of the analyzed pebbles ranges from 0.70 to .072, with mean of 0.75 ; Oblate-prolate index (OP) varies from -1.23 to 2.31 with a mean of 0.80 and the estimated roundness ranges from 27% to 39% with mean value of 35%. The forms are pre- dominated Compact Bladed (CB).

The results obtained show that the mean flatness ratio (FR) of 0.57 falls above 0.25 -.035 and 0.35-0.45 of Lutig (1962) for fluvial and beach dominated environment. The flatness index (FI) or coefficient of flatness ratio (CFR) ranges from 52% to 59% with average mean of 57% measured sampled falling above the lower limit values of 45% (Lutig, 1962) that separates beach (FI < 45%) from fluvial (FI > 45%) depositional environment setting. The mean elongation ratio (ER) for pebbles of Awi Sandstone evaluated is 0.76 which is approximately within 0.65-0.75 range of Lutig (1962), torrent type flowing water or brooks and rivulets.

Maximum Projection Sphericity Index (MPSI) averages 0.68 for rivers; 0.64 for low-wave-energy beach and 0.58 for high-wave-energy beaches (Dobkins and Folk, 1970). The mean value of MPSI in Awi Formation is 0.75 (ranges from 0.70-0.76) inferred river dominated influence. The oblate-prolate (OP) ranges from 1.23 to 2.31 with a total mean of 0.80 with dominant values greater than -1.5; lower empirical limits of Dobkins and Folk (1970) which distinguishes beach dominated pebbles from river..

Roundness is not really a good paleoenviroenmental indicator but is a function of both inherited and acquired environmental factors (Sames, 1966 and Dobkins and Folk, 1970). It is important to note that with prolonged transport (caused by recycling of sediments within the basin) roundness increases in both fluvial and shoreline environments, so that pebbles from both environments have indistinguishable roundness values. Roundness over 45% indicates littoral environment, while values less than 35% characterized fluvial origin (Sames, 1966). The pebble suites of Awi Formation have roundness mean value of 35% (angular) and range from 27% -35% (very angular to angular) with majority of the values within fluvial influences. The range values of this roundness in the study section correspond with the values of 0.375- 0.508 for roundness

(Dobkins and Folk, 1970). This may show short distance of travel, likely from the provenance which is the Oban Massif basement complex.

Morphometric scatter plots were constructed from pebble suites of the area under investigation. From Stratten (1974) bivariate plots of flatness index (CFR) vs. sphericity index (MPSI) in figure 5 shows pebbles shaped by fluvial processes have CFR and MPSI above 45% and 0.66 limit lines and beach falls below these limit lines values respectively. From Figure 5, most plotted values signifying fluvial setting. The plots of roundness against elongation ratio (ER) in Figure 6 shows short distance travel of river influence for the pebble from Awi Formation, which might arise from weathering of the basement rocks of Oban Massif of Nigeria. The scatter plot of sphericity index (MPSI) against oblate - prolate index (OPI), in Figure 7a, is based on studies and values calculated by Dobkins and Folk's (1970). MPSI values above 0.66 line, is fluvial while values less than 0.66 indicates beach influence. It therefore means beach pebbles have a much lower sphericity than river pebbles and the contrast is greater for the higher energy – beaches. The pebbles are more on the prolate side than the oblate side of the tenary (Figure 7b) and infer river origin. The plotted values show over 80% of all the pebbles fall within the fluvial dominated area while less than 20% fall in the beach zone, indicating a river setting for Awi Formation. Some of the form classes are more diagnostic to the environment than others. According to Sneed and Folk (1958), Dobkins and Folk (1970) and Gale (1990); Compact (C), Elongation (E), Compact Bladed (CB) and Compact Elongate (CE) are most indicative of fluvial action whereas Platy(P), Very Platy (VP), Very Bladed (VB), and Bladed (B) are diagnostic of beach setting. The predominant percentage occurrences of Compact Bladed (80% CB) over Bladed (20% B) show fluvial activities in the study area.

Conclusion

The pebble morphometry of Awi Formation studied involved parameters such as flatness ratio (FR), coefficient of flatness ratio (CFR), elongation ratio (ER), maximum projection sphericity index (MPSI), oblate-prolate index (OPI), and roundness, together with some bivariate plots of these parameters to infer the environment of this deposit. The results show that the pebbles of Awi Formation were deposited in a low energy fluvial environment.

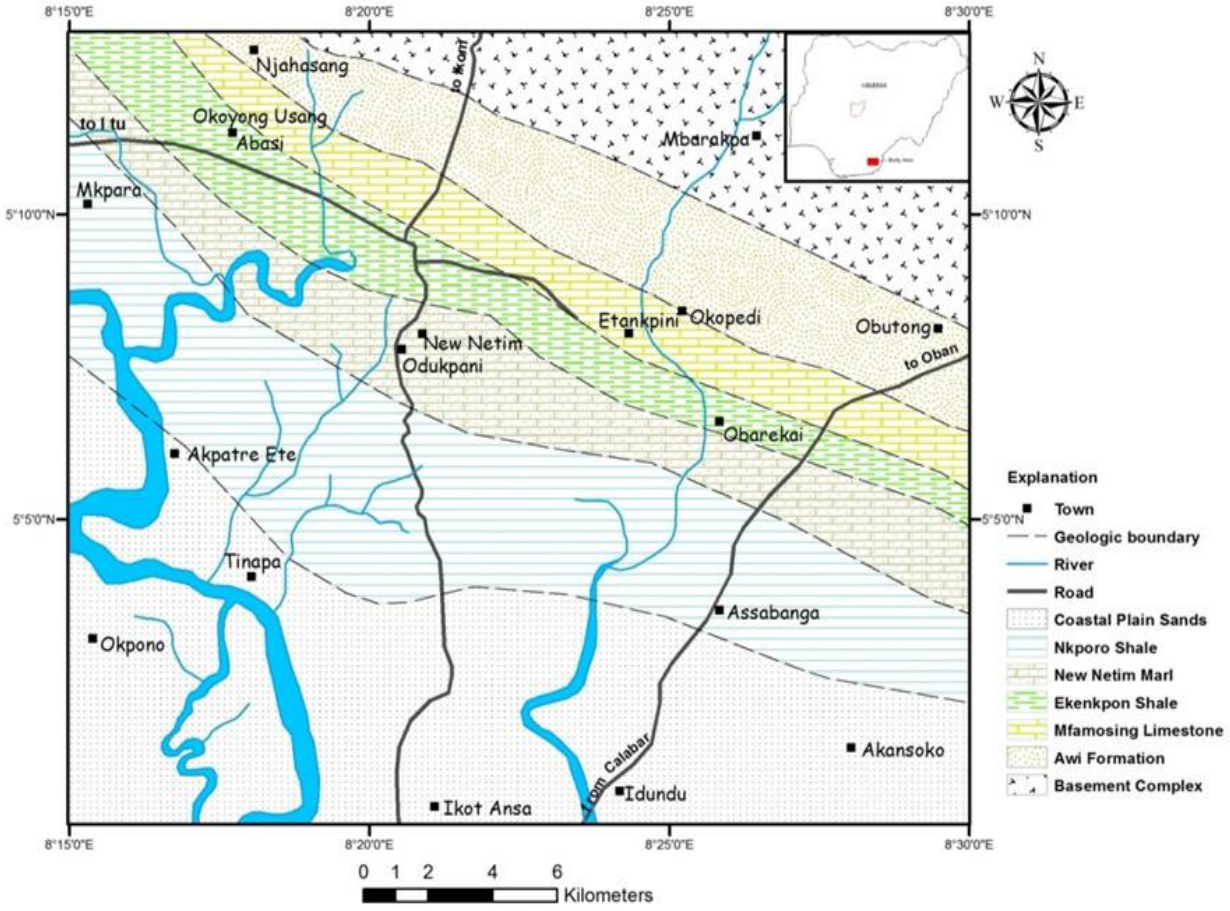


Figure I : Map showing the stratigraphic units of Calabar Flank (Nyong, 1995).

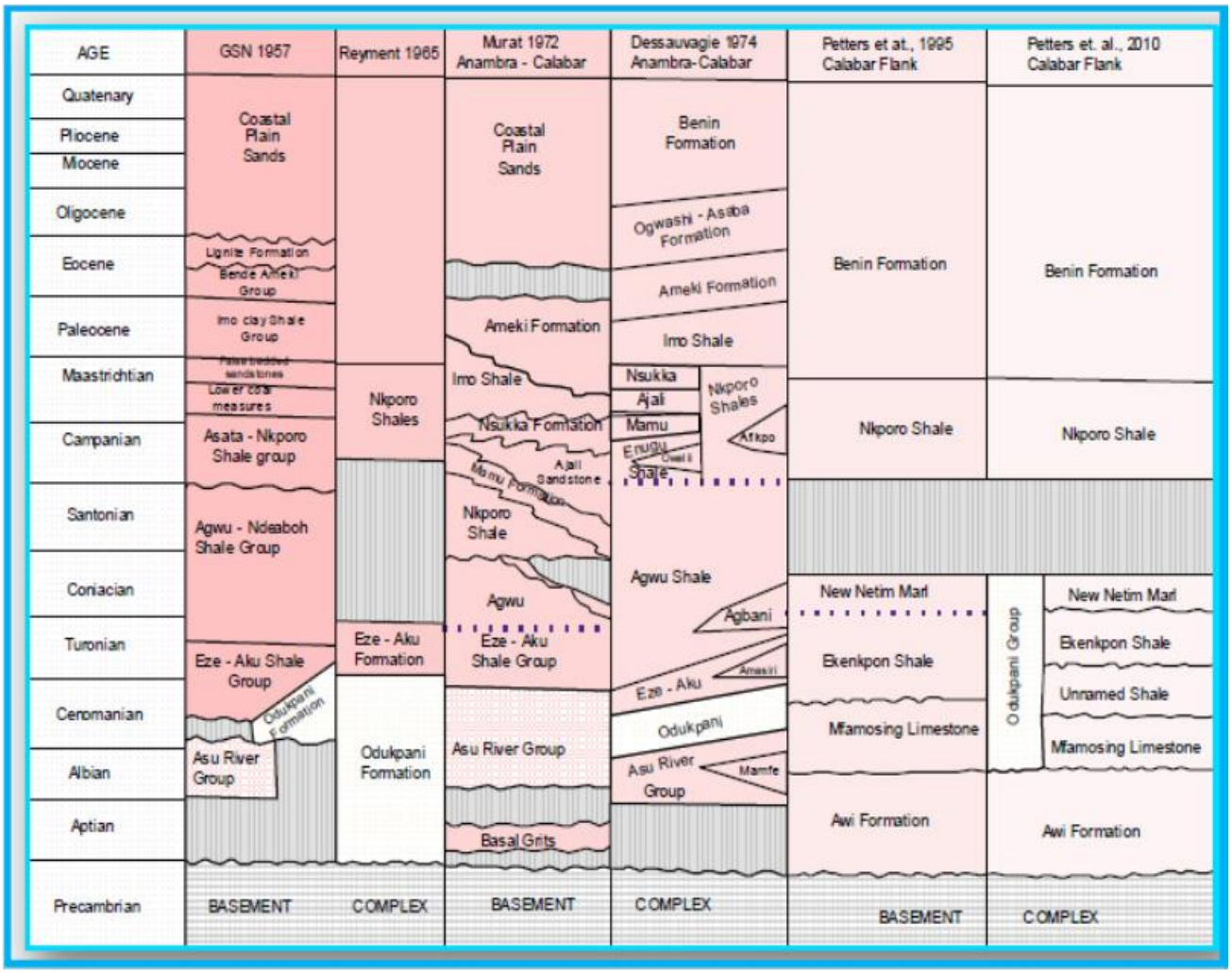


Table 1: Stratigraphic correlation between Calabar Flank and other Nigerian sedimentary basins (Nyong, 1995 and Petters et al., 2010)

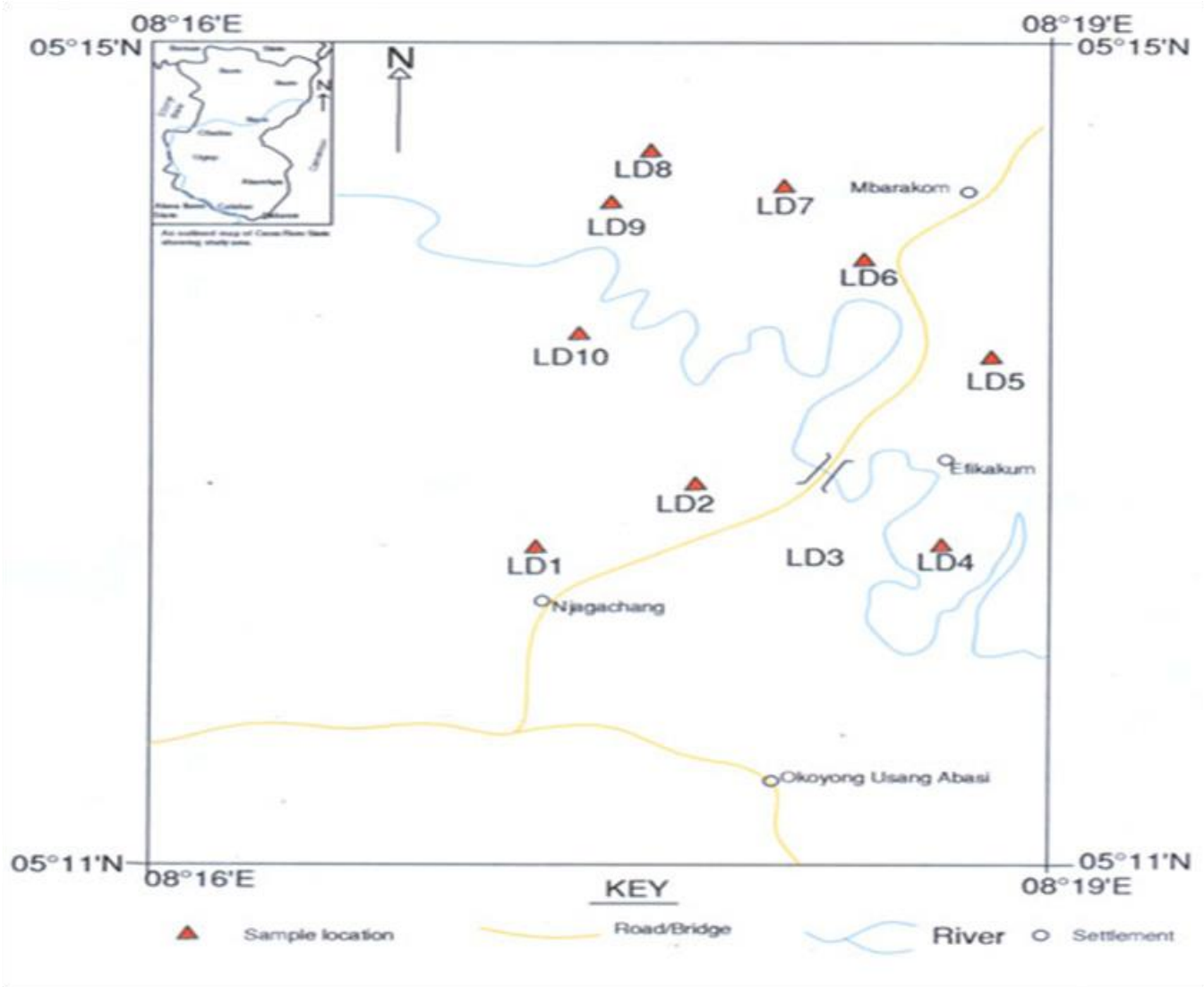


Figure 2: Map of the study area showing locations of the investigated outcrops

Figure 3: Matrix supported conglomerate in the study area

LOC	L (cm)	I (cm)	S (cm)	I/L	S/L	CFR = ((S/L)*100)	L-I/L-S	MPSI	OPI	Form	Roundness(%)
1	2.57	2.11	1.48	0.82	0.59	58.79	0.43	0.75	-1.23	CB	38
2	2.35	1.78	1.34	0.78	0.59	58.95	0.53	0.76	0.73	CB	34.5
3	2.69	2.09	1.36	0.77	0.52	51.98	0.47	0.70	-0.69	B	32.67
4	2.34	1.82	1.34	0.78	0.58	58.08	0.53	0.75	0.42	B	39.83
5	2.28	1.73	1.27	0.77	0.57	56.97	0.54	0.75	0.69	CB	33.5
6	2.14	1.60	1.19	0.76	0.57	57.18	0.57	0.75	1.23	CB	34.5
7	2.25	1.69	1.28	0.76	0.58	57.62	0.57	0.76	1.20	CB	34.83
8	2.59	1.95	1.41	0.75	0.55	55.07	0.59	0.74	1.29	CB	27
9	2.39	1.76	1.36	0.74	0.58	57.85	0.62	0.76	2.04	CB	40.83
10	2.51	1.77	1.35	0.72	0.55	54.75	0.62	0.74	2.31	CB	34.67
MEAN	2.41	1.83	1.34	0.77	0.57	56.72	0.56	0.75	0.79		35.03

Table 2: Summary of pebble morpho-analysis of conglomerate bed of the investigated area.

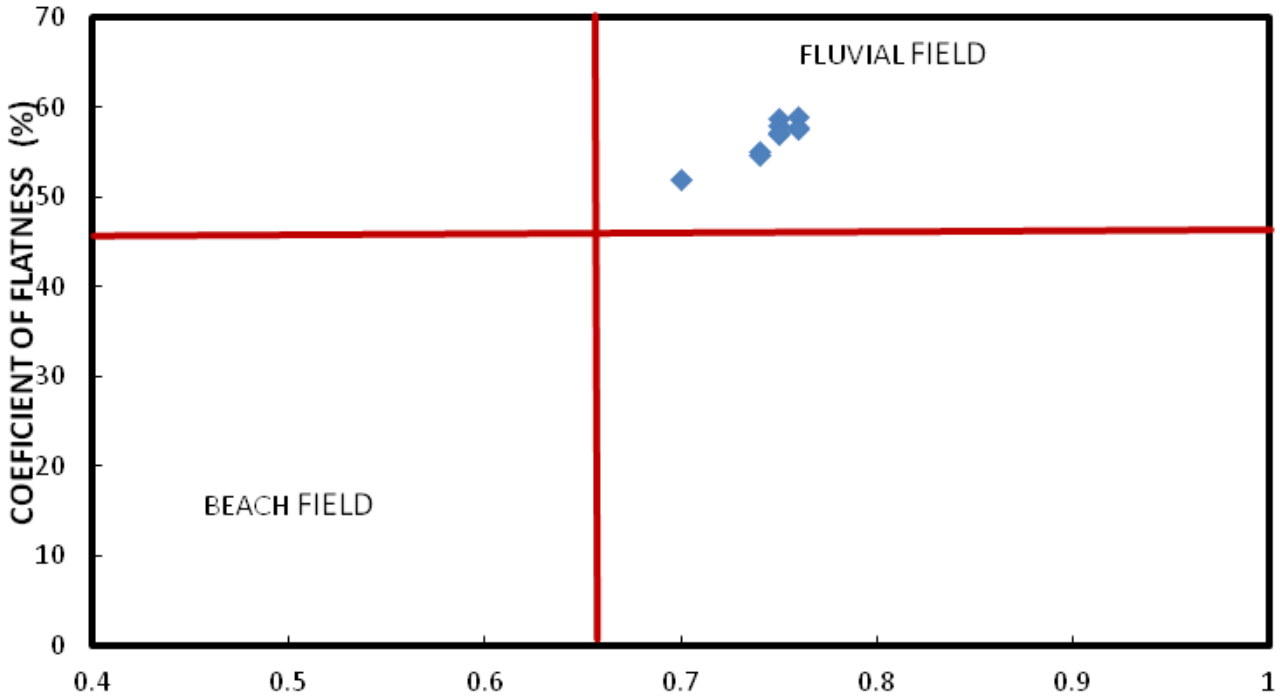


Fig 5 : Bivarite plot of mean values coefficient of flatness (CF) against maximum projection sphericity index(MPSI) from the study area.

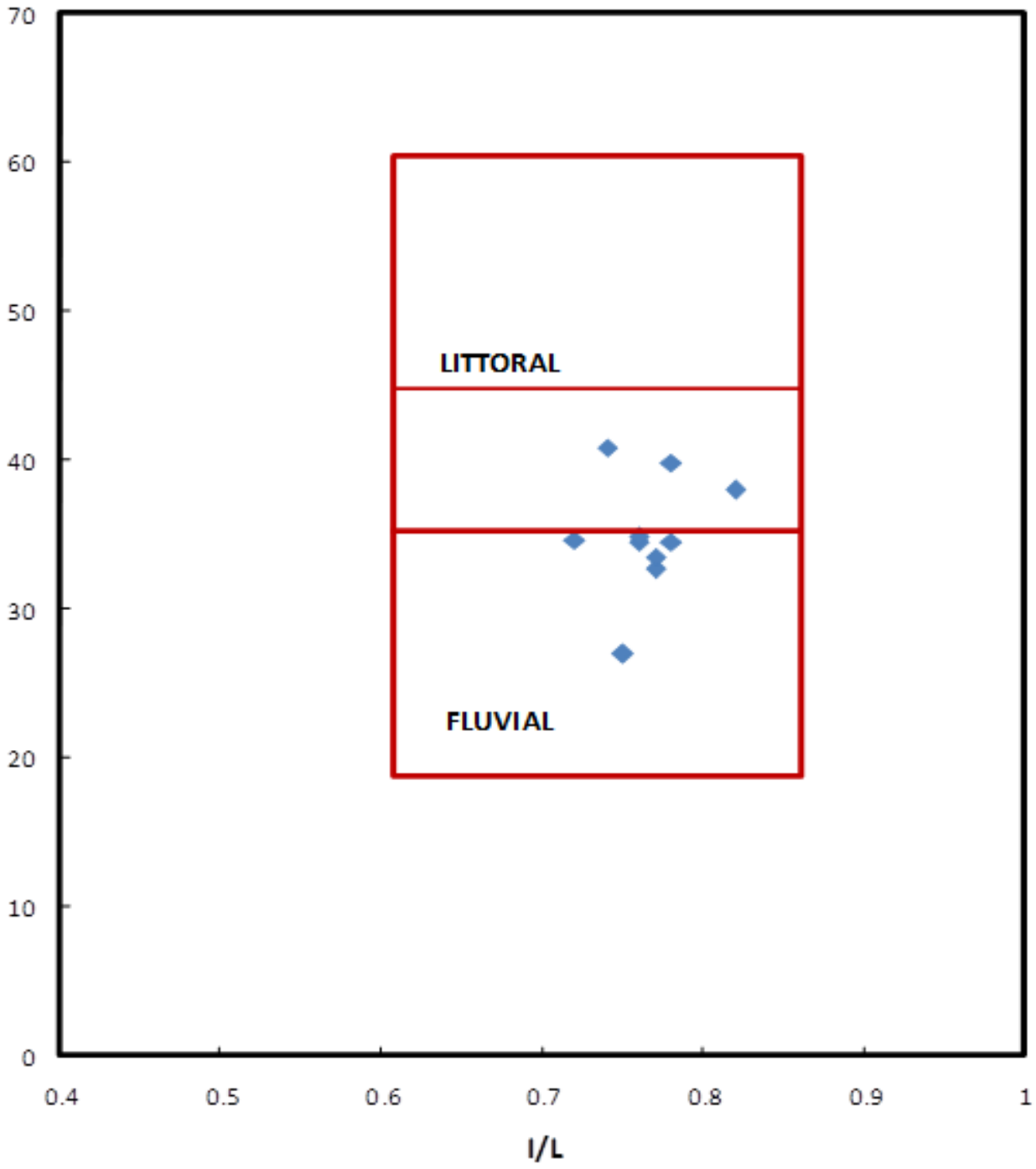
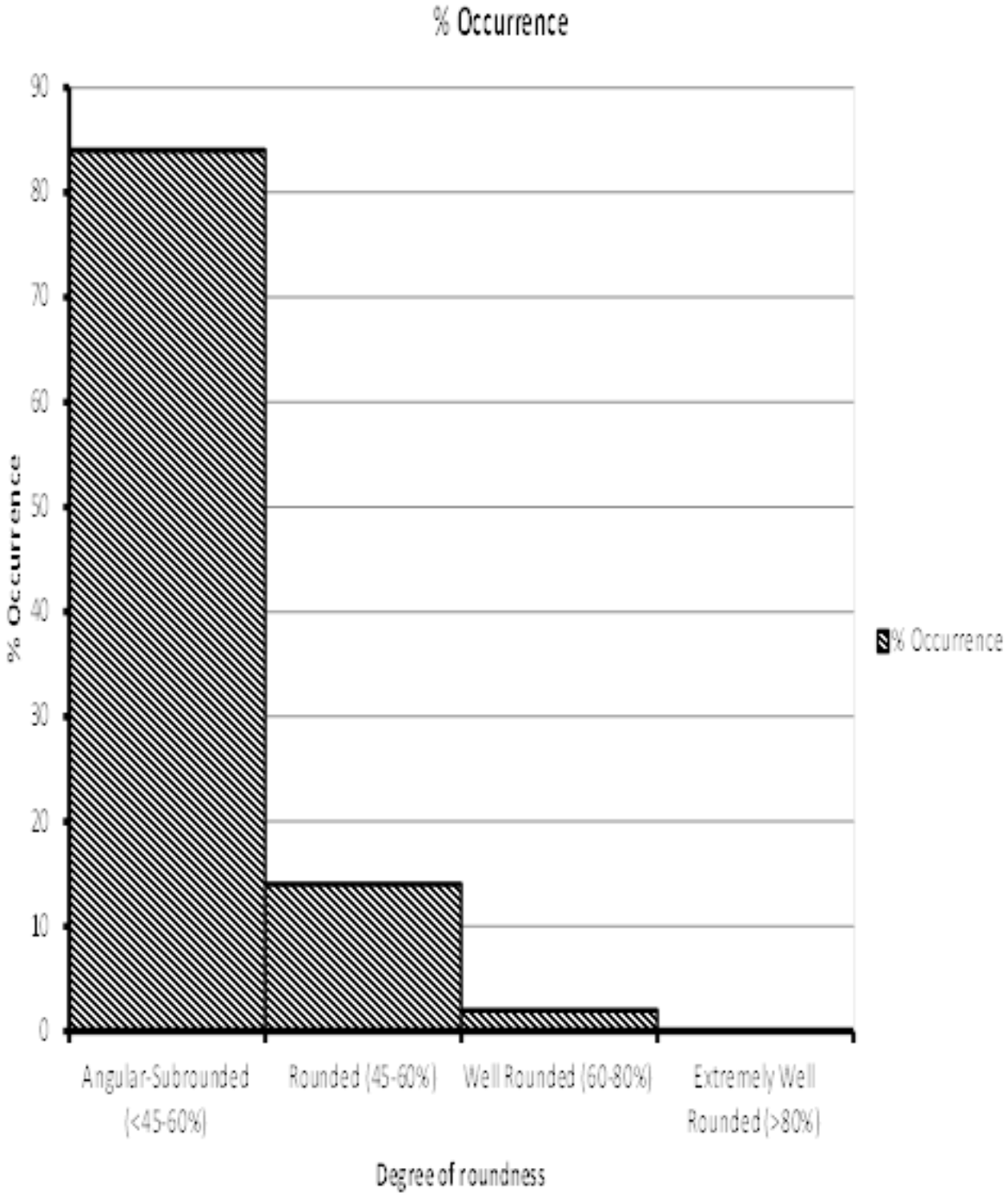


Fig. 6: Plot of mean values of roundness against elongation ratio.



6b. Histogram of mean value of the roundness in the study area

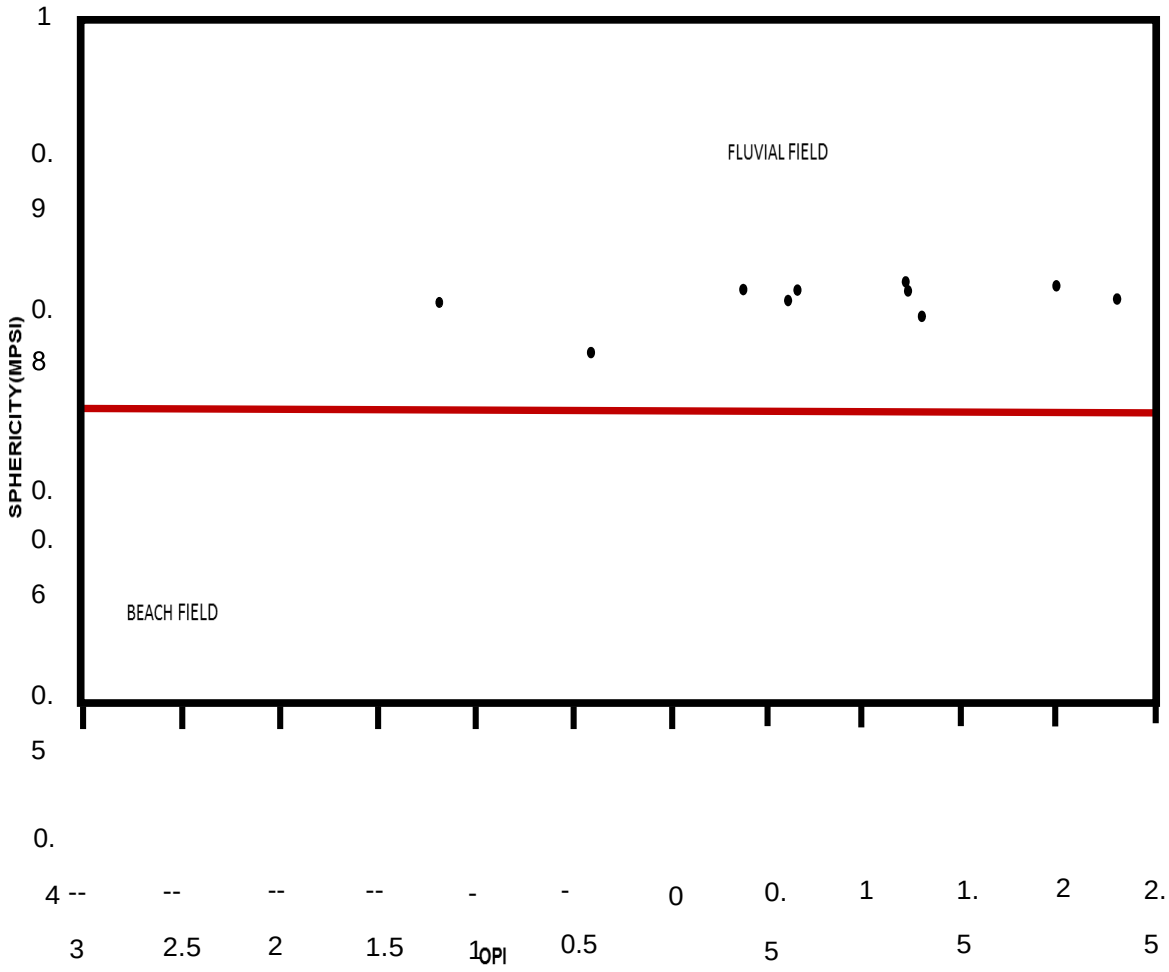


Fig7a. Bivarate plot of mean maximum projection sphericity index (MPSI)

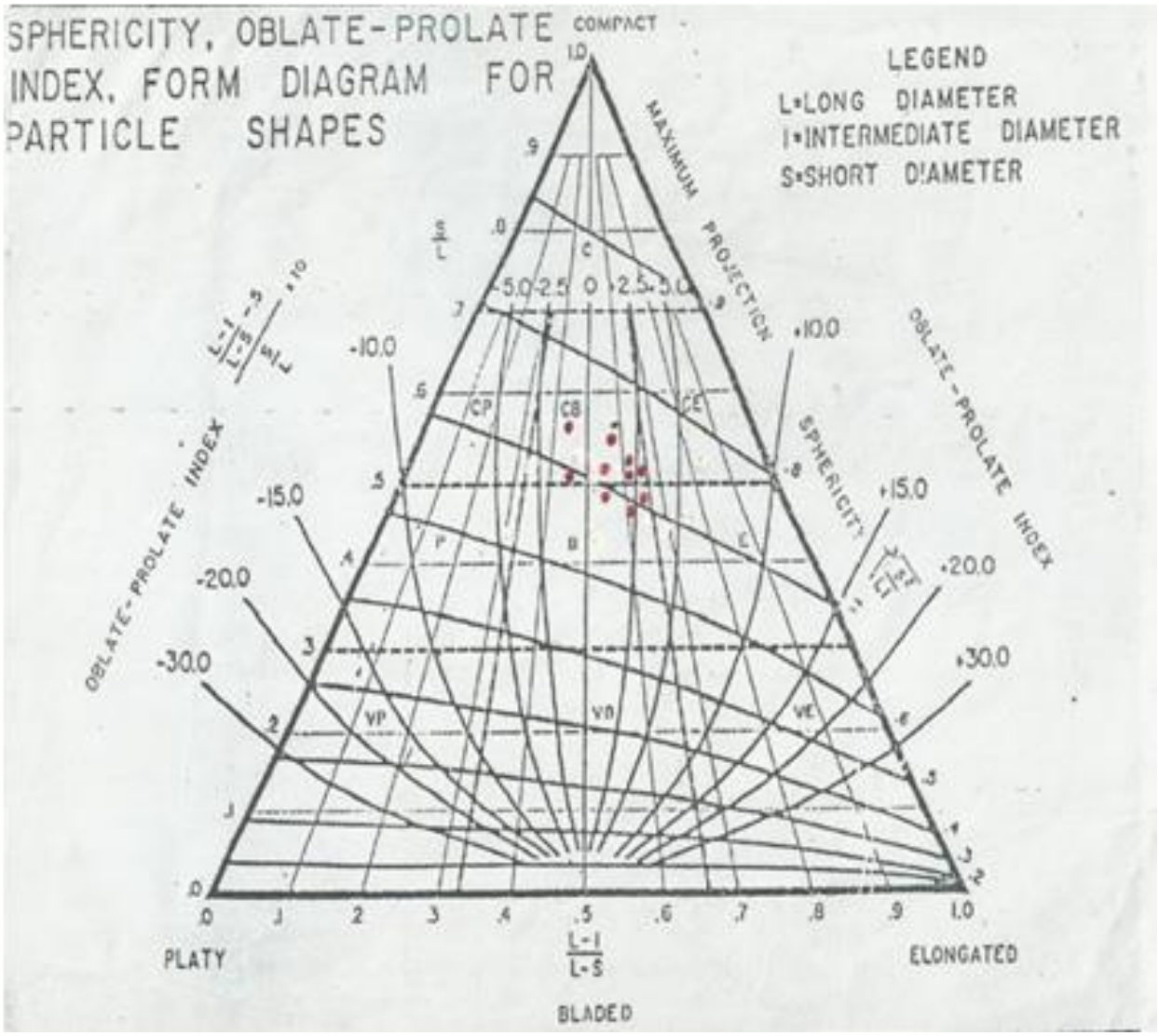


Fig 7 b. Ternary diagram showing the various forms names in the study are against oblate –prolate index (OP) in the study area

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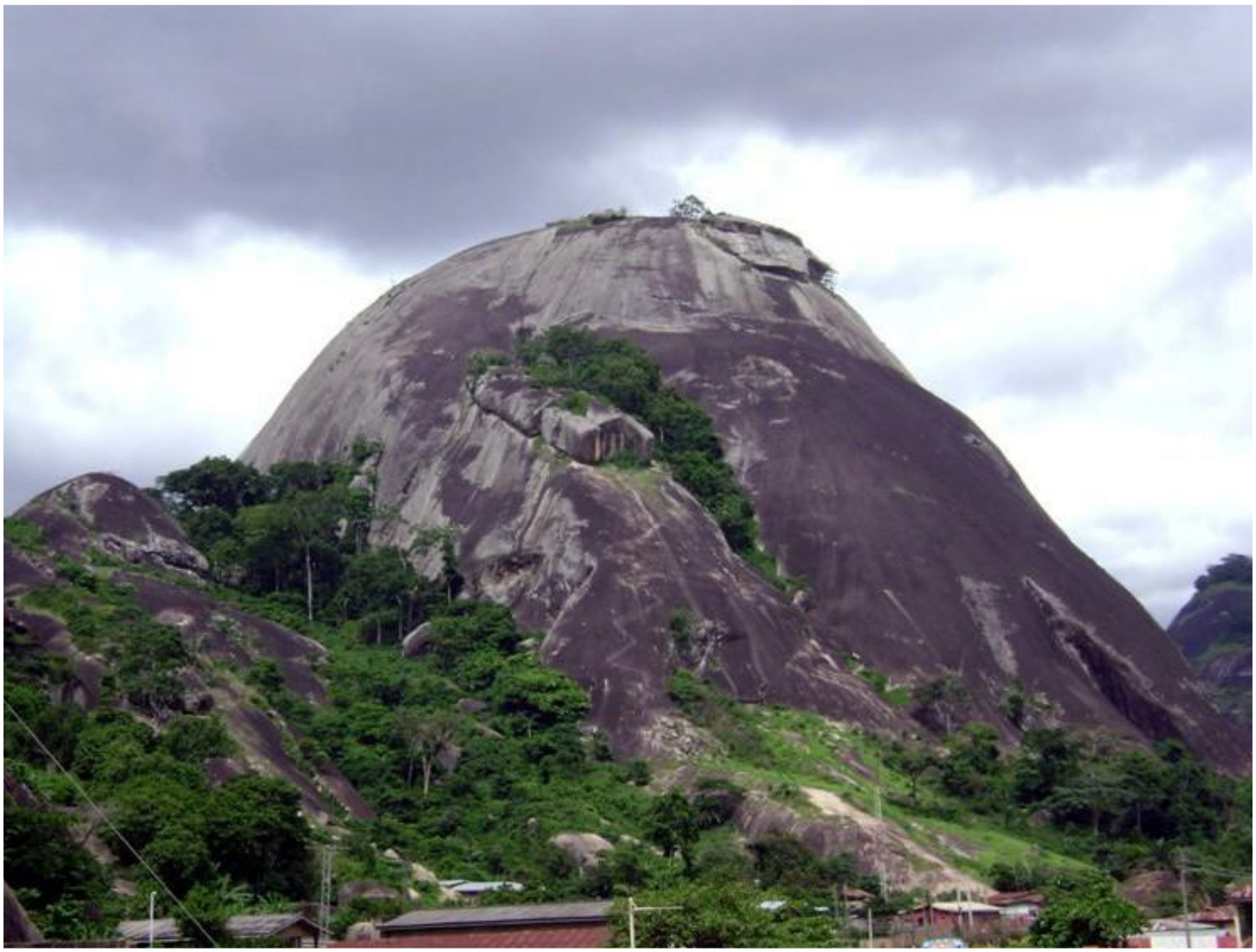

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