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# Micro-features of dunes particles in Kuwait

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**Abstract**

Study the Micro-features of particles can provide outstanding information about the history. Also, it can show the properties of these particles and what can it carry from diseases or pollen. Furthermore, physical and chemical properties were taken into consideration in analyzing aeolian samples. The aim of this work is to study the chemical and physical particles properties of dunes micro-particles in Kuwait. Sand dunes within different locations within same wind corridor. Different locations of sand dunes in Kuwait were allocated for sampling, and then chemical and physical analysis performed using the Scanning Electron Microscope (SEM). The chemical and physical study of shows that the quartz particles located downwind in the southeast tend to be more rounded and smooth compared with those upwind in the northwest. It was observed that mechanical surface features on the surfaces of quartz particles occur mostly in the form of dish shaped depressions, V-shaped pits, upturned plates, rounded, and crescentic pits, respectively.

*Keywords:* Micro-features; Aeolian dunes; quartz particles;

## 1. Introduction

Sand particles can show lot information about the sand origin and properties. Newsom and Ladd, 1999[1] studies the use of quartz grain microstructures in the study of the origin of sand terrains in westrn Australia. Researchers start to study sand particles using scanning Electron microscope (SEM). Scanning electron microscopic techniques were applied to the study of sediments by a number of investigators[2-5].

SEM has often been proven useful for determining the transportation history of sand grain [6,7] The surface of the quartz grains is affected usually by different mechanical and chemical processes with distinctive features. Such features were largely described by Krinsley and Doornkamp, 1973 [4]. Micro-textures on sand grains, including micro-fractures, abrasion, etching and coating, may provide important information on paleo-environmental history, including aeolian activity and severity of weathering inferred from etching and dissolution features. The identification of sources and genesis using the surface textures of quartz grains and various detrital sediments has been used by [2, 4, 5, 8, 9]

The use of Scanning Electron Microscope (SEM) to study the surface micro features particle become a revolution in the geological study. In the SEM more details are observable, where grains can be observed and examined in detail at either high or low magnifications. Also, the SEM gives a simulated three dimensional views of object which simplifies interpretation.

The lack of mechanicaly derived microstructures, such as upturned plates, percussion, scratcher, crackes, conchaded fracture and V-shape pits in the Victoria plateau contrasts in general with the Aeolian stand sheets of Kuwait [7, 8]. Sand grains from obvious dunes bed forms such as Tenindewa and Balla-Whellares Road does not have roundness shapes, Values or microtexture that indicate the transport over long distances.

The presence of iron oxide deposit in the quartz particle leads to the color variation in sand. Some studies stated that the origin, composition and transport history could be known from the shape of the sand particles. Lancaster (1995)[10] studies individual microscopic images of sand particles; he found that, the color variations of the sand are achieved by the presence of iron oxides deposits on pits and frosted quartz particles. The three-dimensional stereoscopic scatter plots to plot the three parameters of Munsell colors (hue, value, and chroma) were used by Wells (2002)[11]. Also number of researchers studies the particle color of the dune sand in different locations, the Strzelecki dune field of Australia [12], the Namib sand sea [13], Portuguese beach dunes[14], and the Simpson Desert [15]. Others claimed that dune sand become lighter in color at downwind from source area [16]. (Pye and Tsoar 1990)[17] stated that, the shape of sand particles can be determined by their composition, origin, and transport history. Experimental work done by Kuenen (1960) [18]suggests that wind rounds 100–1,000 times faster than fluvial action. Goudie and Watson (1981)[19] suggested that

the roundness of aeolian sand particles result from the fact that particles transported in water possess a tightly adherent film of water, which protects them from impact.

The mechanical and chemical features on quartz particles from different environments were briefly described by Krinsley and Doornkamp (1973)[4]. Microfeatures on sand particles, including microfractures, abrasion, coating, and etching, can provide important information on paleoenvironmental history, including aeolian activity and severity of weathering inferred from etching and dissolution features. Culver et al. (1983)[20] used the scanning electron microscope (SEM) analysis to study the quartz particle surface features to discriminating between samples from different environments, but he stated theat the use of one microfeature to determine paleoenvironment is an invalid approach. Krinsley and Funnell (1965)[2] suggested that a series of events representing a succession of environments may be recorded on a single sand particle or group of particles.

The Brunauer, Emmett, and Teller (BET) surface area is expressed as values for a certain weight of loose sand in terms of square meter per gram measured by using isotherm plot diagrams of volume against pressure and using the BET equation invented by Brunauer et al. (1938)[21].

Previous studies on aeolian sediments in Kuwait region and elsewhere have focused on sedimentimophic features [3, 22, 23] Iraq [24], Oman [25], Jordan [26], Emirates [27], and Saudi Arabia [28]. However the physical properties of aeolian sand particles were not been investigated. Therefore, this study aims to discuss this knowledge in order to model sand transport for industrial and environmental planning purposes.

The development of nanotechnology and the manufacture of new organic and inorganic nanosized materials may result in the release of substantial amounts of these materials into the environment. The fate and transport of nanosized materials, once they are released into the environment, has not yet been fully addressed, nor have the impacts of those materials on plants and soil communities [29].

## 2. Methodology

Number of samples from different places were randomly collected from the surface of sand drifts nabkhas, and sand dunes within north and north west of Kuwait. The samples were collected from top 5 cm of the dune surface. Particle size were measured using standard sieving and sedimentation technique [30].

The main physical properties taken into consideration in analyzing the samples are color, shape, roundness, particle morphology, and surface area.

## 3. Results and discussions

The visual observation and other physical property results between the upwind and downwind samples shows similarity in the color, which indicates similar origin.

The measurement of the particle shape parameters (area, diameter, elongation, and perimeter) shows that the upwind samples have slightly higher values than the downwind samples (fig 1). The diagrams of area and perimeter show a high correction between upwind and downwind (R2=0.95 and 0.96 respectively).

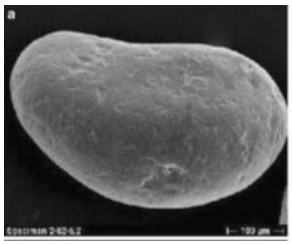

Fig.1 Larger particles (upwind)

It appears from fig (2) the surface microfeatures of quartz particles have been subjected to both mechanical and physical action.

The microfeatures observed are V-shape pits, rounded pits, crescentic pits, dish shape depression, and upturned plates. The main distributed features on the surface of quartz particles are, V-shape pits and rounded pits (fig 2) with a size from 5 to 50 Um.

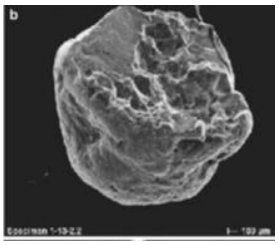

Fig. 2 V-shape and rounded pits

Also, Groove and etching appears in the surface of some particles (fig3), other particles show extensive fractureing and

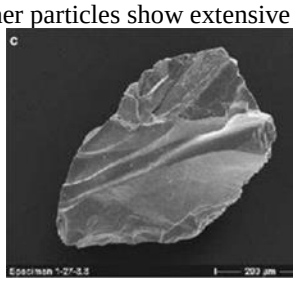

Fig. 3 Groove and etching

abrasion (fig4) the regular quartz particles are usually rich in microfeatures such as cracks, and fractures, and sutures. Dish-shaped depression and mechanical pits predominantly influence the visual appearance masking the cracks and fractures (fig5).

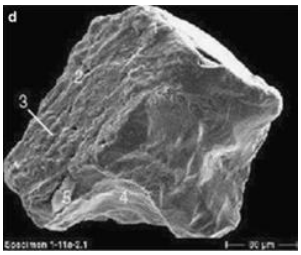

Fig.4 extensive fractureing and abrasion

The only abundant chemical microfeatures occure within this study is irregular solution and silica precipitation, other chemical microfeatures are overlapped by mechanical microfeatures such as conchoided features and deep triangular pits (fig6)

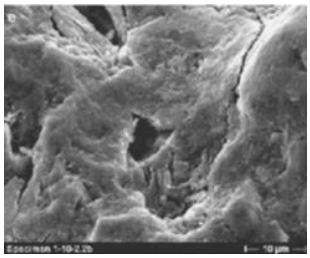

Fig. 5 dish-shaped and mechanical pits

Finally, the upwind particles (Northwest) shows more mechanical and chemical features compared with the downwind particles (southeast)

The main features in the upwind samples are upturned plates, dish-shaped depressions, V-shaped pits, and rounded and crescentic pits, respectively, while, the dominant features in the downwind samples upturned plates are irregular solution precipitation, rounded and crescentic pits, and V-shaped pits, respectively. The dish shaped depressions were not noticed frequently in the downwind samples compared to the upwind samples.

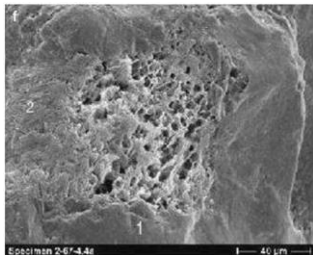

**Figure 6:** deep triangular pits

## 6. Conclusions

The study of physical properties of sand particles within the Kuwait Aeolian deposits shows unique characteristics. The particles are similar in color within the local scale between upwind and downwind samples. In addition, four main particle shape parameters (area, equivalent diameter, elongation, and perimeter) show a strong similarity is between upwind and downwind. Variations within these properties are absent or limited. The microscopic analysis of quartz particle in the Scanning Electron Microscopy shows the transportation influence of individual particles on the microfeatures. Wind abrasion and impact between particles remove corners and produce upturned plates around fractures and cracks. While the overall particle shape appears to have been changed only to a limited extent.

## References


[1] David Newsom and Philip Ladd (1999) The use of quartz grain microtextures in the study of the origin of sand terrains in Western Australia. Catena 35, 1-17

[2] Krinsley DH, Funnell BM (1965) Environmental history of quartz sand grains from the lower and middle Pleistocene of Norfolk, England. Q J Geol Soc Lond 121, 435–461

[3] Khalaf FI, Misak R, Al-Dousari AM (1995) Sedimentological and morphological characteristics of some nabkha deposits in the northern coastal plain of Kuwait, Arabia. J Arid Environ 29, 267– 292

[4] Krinsley D, Doornkamp J (1973) Atlas of quartz sand surface textures. Cambridge University Press, Cambridge

[5]Al-Dousary and Al-Hazza (2013) Physical properties of aeolian sediments within major dune corridor in Kuwait. Arab J Geosci, 6, 519–527

[6] Bull and Goudie (1987) An examination of the ability of environmental reconstruction by SEM studies: a case study from the plateau drift deposits of Oxfordshire, England

[7] Mazzullo, Magenheimer (1987) The original shapes of quartz sand grains. Journal of Sedimentary, 57, 479-487

[8] Al-Saleh and Khalaf (1982) Surface textures of quartz grains from various recent sedimentary environments in Kuwait. Journal of Sedimentary Research 52, 215-225

[9] Mahaney, Hancock, Aufreiter, and Huffman (1996) Geochemistry and clay mineralogy of termite mound soil and the role of geophagy in chimpanzees of the Mahale Mountains, Tanzania. Primates 37, 121-134

[10] Lancaster N (1995) Geomorphology of desert dunes. Routledge, London

[11] Wells NA (2002) Quantitative evaluation of color measurements: I. Triaxial stereoscopic scatter plots. Sed Geol. 151, 1–15

[12] Wasson RJ (1983) Dune sediment types, and colour, sediment provenance and hydrology in the Strzelecki-Simpson dunefield,

[13] Walden J, White K, Drake N (1996) Controls on dune colour in the Namib sand sea: preliminary results. J Afr Earth Sci 22(3):349– 353

[14] Guedes A, Ribeiro H, Valentim B, Noronha F (2009) Quantitative colour analysis of beach and dune sediments for forensic applications: a Portuguese example. Forensic Sci Int 190, 42–51

[15] Pell S, Chivas A, Williams I (2000) The Simpson, Strzelecki and Tirari Desert: development and sand provenance. Sed Geol. 130,107–130

[16] White K, Bullard J (2009) Abrasion control on dune colour: Muleshoe Dunes, SW USA. Geomorphology. 105,59–66

[17] Pye K, Tsoar H (1990) Aeolian sand and sand dunes. Unwin Hyman, London, p 396 Saqqa

[18] Kuenen P (1960) Experimental abrasion-eolian action. J Geol. 68,427– 449

[19] Goudie AS, Watson A (1981) The shape of desert sand dune grains. J Arid Environ. 4, 185–190

[20] Culver SJ, Bull PA, Campbell S, Shakesby A, Whalley WB (1983),Environmental discrimination based on grains surface textures: a statistical investigation. Sedimentology. 30,129–136

[21] Brunauer S, Emmett PH, Teller E (1938) Adsorption of gases in multimolecular layers. J Am Chem Soc 60:309–319 Culver SJ, Bull PA, Campbell S, Shakesby A, Whalley WB (1983)

[22] Al-Dousari AM, Pye K (2005) Mapping and monitoring of dunes in northwestern Kuwait. Kuwait J Sci Eng. 32(2),119–134

[23] Al-Dousari AM, Misak R,Ahmed M, Al-MutairiM(2008) Characteristics of nabkhas in relation to dominant perennial plant species in Kuwait. Kuwait J Sci Eng 35:129–150

[24] Al-Janabi KZ, Jawad Ali A, Al-Taie FH, Jack FJ (1988) Origin and nature of sand dunes in the alluvial plain of southern Iraq. J Arid Environ. 14, 27–34

[25] Pease PP, Bierly GD, Tchakerian VP, Tindale NW (1999) Mineralogical characterization and transport pathways of dune sand using Landsat TMdata,Wahiba Sand Sea, Sultanate of Oman. Geomorphology. 29, 235–249

[26] Saqqa W, Attallah M (2004) Characterization of the aeolian terrain facies in Wadi Araba Desert, southwestern Jordan. Geomorphology. 62, 63–87

[27] El-Sayed MI (2000) The nature and possible origin of mega-dunes in Liwa, Ar Rub' Al Khali, UAE. Sed Geol 134(3–4):305–330

[28] Al-Fredan MA (2008) Sand dune and sabkha vegetations of Eastern Saudi Arabia. Int J Bot. 4, 196–204

[29] Dionysiou (2004) Environmental applications and implications of nanotechnology and nanomaterialsJ. Environ. Eng. ASCE. 130, 723–724

[30] Blott SJ, Pye K (2001) GRADISTAT: a grain size distribution and statistics package for the analysis of unconsolidated sediments. Earth Surf Proc Land. 26, 1237–1248

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The 1st International Conference on Energy, Environment and Economics (ICEEE 2016) was held at Heriot-Watt University, Edinburgh, EH14 4AS, UK, 16-18 August 2016. ICEEE2016 focused on energy, environment and economics of energy systems and their applications. More than fifty eight delegates from 31 countries with diverse expertise ranging from energy economics, solar thermal, water engineering, automotive, energy, economics and policy, sustainable development, bio fuels, Nano technologies, climate change, life cycle analysis etc. made conference true to its name and completely international. During conference total 51 oral presentations and six posters were shared between delegates. The presentations showed the depth and breadth of research across different research areas ranging from diverse background. ICEEE2016 aimed:

- To identify and share experiences, challenges and technical expertise on how to tackle growing energy use and greenhouse gas emissions and how to promote sustainability and economical, cost effective energy efficiency measures.

In total 11 technical sessions and two invited talks both from academia and industry provided insight into the recent development on the proposed theme of the conference. Preparation, organisation and delivery of the conference started from July 2015 and further co-ordinated by vibrant team of Conference Centre, Heriot Watt University. Conference organisers would like to acknowledge support from the sponsors particularly World Scientific Publication ltd and its team members for the delivery of the conference. Organisers are also thankful to all reviewers who contributed during peer review process and their contributions are well appreciated. At the end and during vote of thanks following awards have been announced and we would like to congratulate all well deserving delegates.

- Best Paper –Academia: Amela Ajanovic, EEG, TU Vienna, Austria
- Best Paper – Student : Christian Jenne,University of Duisburg-Essen, Germany
- Best Poster – Student: Yoann Guinard, University of New South Wales, Sydney, Australia
- Best Poster – Academia: E. Salleh, Universiti Kebangsaan Malaysia, Malaysia
- Active Participation Award - Yoann Guinard, University of New South Wales, Sydney, Australia

At the end we would like to extend our gratitude to all of you for your participation and hopefully welcome you again during ICEEE2017.

**Editors:**
**Dr. Singh** is Senior Scientist at Indian Agricultural Research Institute, New Delhi, India. Her area of expertise are bio energy and bio fuels, environmental engineering, carbon accounting and renewable energy integration for rural development.
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