1-The role of salt weathering in the origin of the Qattara Depression, Western Desert, Egypt

Aref, MAM (Aref, MAM)
[1] Cairo Univ, Fac Sci, Geol Dept, Giza, Egypt

El-Khoriby, E (El-Khoriby, E)
[2] Mansoura Univ, Fac Sci, Geol Dept, Mansoura, Egypt

Hamdan, MA (Hamdan, MA)
[3] Mansoura Univ, Fac Sci, Geol Dept, Mansoura, Egypt

Abstract

Field studies and petrographic examinations of core samples and of the bedrock of the floor of the Qattara Depression, Egypt, indicate that salt weathering predominates in its western part in marked contrast to its eastern part. The eastern part of the depression is covered with more than 120-cm-thick, moist sands with sporadic occurrence of halite and gypsum due to the low salinity of the groundwater table. At the western part of the depression, the strongly saline, sodium chloride nature of the groundwater table favors crystallization of halite (and sometimes gypsum) at or near the surface of the outcropping bedrock of the Moghra clastics and/or Dabaa shale. Crystallization of halite and/or gypsum generates increased pressure that leads to mechanical disintegration of the bedrock into fine-gained debris. Features related to disintegration include blistering of the rock surface, splitting, spalling and/or granular disintegration. Alternation of dry and wet cycles favor halite crystallization, mechanical disintegration of the outcropping bedrock and dissolution of the halite cement, which exposes fine-grained debris to wind deflation. Removal of the debris from the floor of the depression leads to the accumulation of lunettes and other dunes in the downwind direction. Therefore, salt weathering provides fine-grained debris that are easily removed by deflation, which accounts for the topographically lower level of the western part of the depression (134 m below sea level (b.s.l.)). in contrast, the presence of moist sediments at the eastern part of the depression inhibits deflation and encourages sedimentation by adhesion of wind-blown sand to the damp surface of the sabkha at an elevation of 45 in below sea level. The disintegration of the bedrock of the Qattara Depression by salt weathering has been in effect since the onset of aridity in northern Egypt in Quaternary time. Whereas the initial excavation of the depression started in Late Miocene or Pliocene time by fluvial erosion, karstic process, mass-wasting and wind deflation. (C) 2002 Elsevier Science B.V All rights reserved.

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Reprint Address: Aref, MAM (reprint author)
Cairo Univ, Fac Sci, Geol Dept, Giza, Egypt.

Author Identifiers:

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References;

1. Title: ORIGIN OF THE QATTARA DEPRESSION, EGYPT

Author(s): ALBRITTON, CC; BROOKS, JE; ISSAWI, B; et al.

Source: GEOLOGICAL SOCIETY OF AMERICA BULLETIN Volume: 102 Issue: 7 Pages: 952-960 Published: JUL 1990

2. Title: [not available]Author(s): AREF MAM

Source: IN PRESS SEDIMENTOLO Volume: 10 Published: 2002

3. Title: THE QATTARA DEPRESSION OF THE LIBYAN DESERT AND THE POSSIBILITY OF ITS UTILIZATION FOR POWER-PRODUCTION -Author(s): Ball, John

Source: GEOGRAPHICAL JOURNAL Volume: 82 Issue: 4 Pages: 289-314 DOI: 10.2307/1785898 Published: OCT 1933

4. Title: PROBLEMS OF THE LIBYAN DESERT -Author(s): Ball, John

Source: GEOGRAPHICAL JOURNAL Volume: 70 Issue: 1 Pages: 21-38 DOI: 10.2307/1781881 Published: JUL 1927

5. Title: [not available] Author(s): Bloom, A.L.

Source: Geomorphology: a Systematic Analysis of Late Cenozoic Landforms Published: 1998

Publisher: Prentice Hall, Upper Saddle River

6. Title: [not available] Author(s): BROMBLET P

Source: P 5 INT C DET CONS S Pages: 361 Published: 1985

7. Title: SALT WEATHERING BY SODIUM-CHLORIDE IN THE SAUDI ARABIAN DESERT

Author(s): CHAPMAN, RW

Source: AMERICAN JOURNAL OF SCIENCE Volume: 280 Issue: 2 Pages: 116-129 Published: 1980

8. Title: [not available] Author(s): Doornkamp, J.C.; Brunsden, D.; Jones, D.K.C.

Source: Geology, Geomorphology and Pedology of Bahrain Published: 1980

Publisher: Geo Abstract, Norwich. UK.

9. Title: [not available]Author(s): ELBASSYONY AA

Source: J ELECT ENERGY Volume: 5 Pages: 4 Published: 1990

10. Title: [not available] Author(s): ELBASSYONY AA

Source: SEDIMENTOLOGY EGYPT Volume: 3 Pages: 13 Published: 1995

11. Title: [not available]Author(s): ELRAMLY IM

Source: PUBLICATION INT ASS Volume: 73 Pages: 348 Published: 1967

12. Title: [not available] Author(s): EZZAT MA

Source: GROUNDWATER SERIES A Published: 1974

13. Title: ORIGIN OF THE QATTARA DEPRESSION, EGYPT - DISCUSSION

Author(s): GINDY, AR

Source: GEOLOGICAL SOCIETY OF AMERICA BULLETIN Volume: 103 Issue: 10 Pages: 1374-1375 DOI: 10.1130/0016-7606(1991)103<1374:OOTQDE>2.3.CO;2 Published: OCT 1991

14. Title: [not available] Author(s): Glennie, K. W.

Source: Desert Sedimentary Environments Volume: 14 Published: 1970

Publisher: Elsevier, Amsterdam

15. Title: THE NATURE AND PATTERN OF DEBRIS LIBERATION BY SALT WEATHERING - A LABORATORY STUDY

Author(s): GOUDIE, AS; VILES, HA

Source: EARTH SURFACE PROCESSES AND LANDFORMS Volume: 20 Issue: 5 Pages: 437-449 DOI: 10.1002/esp.3290200505 Published: AUG 1995

16. Title: ROCK BLOCK MONITORING OF RAPID SALT WEATHERING IN SOUTHERN TUNISIA

Author(s): GOUDIE, AS; WATSON, A

Source: EARTH SURFACE PROCESSES AND LANDFORMS Volume: 9 Issue: 1 Pages: 95-98 DOI:

10.1002/esp.3290090112 Abstract Number: A1984-041921 Published: 1984

17. Title: THE NATURE, DISTRIBUTION AND FORMATION OF PANS IN ARID ZONES

Author(s): GOUDIE, AS; WELLS, GL

Source: EARTH-SCIENCE REVIEWS Volume: 38 Issue: 1 Pages: 1-69 DOI: 10.1016/0012-8252(94)00066-6 Published: MAR 1995

18. Title: SALT ATTACK ON BUILDINGS AND OTHER STRUCTURES IN ARID LANDS

Author(s): GOUDIE, AS

Book Editor(s): Fookes, PG; Parry, RHG

Conference: 1st International Symposium on Engineering Characteristics of Arid Soils Location: LONDON, ENGLAND Date: JUL 06-07, 1993

Sponsor(s): CITY UNIV LONDON, GEOTECH ENGN RES CTR; INT SOC SOIL MECH & FDN ENGN TC3 ARID SOILS

Source: ENGINEERING CHARACTERISTICS OF ARID SOILS Pages: 15-28 Published: 1994

19. Title: Experimental simulation of rapid rock block disintegration by sodium chloride in a foggy coastal desert

Author(s): Goudie, AS; Parker, AG

Source: JOURNAL OF ARID ENVIRONMENTS Volume: 40 Issue: 4 Pages: 347-355 DOI: 10.1006/jare.1998.0465 Published: DEC 1998

20. Title: Monitoring of rapid salt weathering in the central Namib Desert using limestone blocks

Author(s): Goudie, AS; Viles, HA; Parker, AG

Source: JOURNAL OF ARID ENVIRONMENTS Volume: 37 Issue: 4 Pages: 581-598 DOI: 10.1006/jare.1997.0297 Published: DEC 1997

21. Title: FORMATION OF SILT FROM QUARTZ DUNE SAND BY SALT-WEATHERING PROCESSES IN DESERTS

Author(s): GOUDIE, AS; COOKE, RU; DOORNKAMP, JC

Source: JOURNAL OF ARID ENVIRONMENTS Volume: 2 Issue: 2 Pages: 105-& Published: 1979

22. Title: PANS IN SOUTHERN-AFRICA WITH PARTICULAR REFERENCE TO SOUTH-AFRICA AND ZIMBABWE

Author(s): GOUDIE, AS; THOMAS, DSG

Source: ZEITSCHRIFT FUR GEOMORPHOLOGIE Volume: 29 Issue: 1 Pages: 1-19 Published: 1985

23. Title: [not available] Author(s): HAMDAN MAA

Source: P 4 INT C GEOL AR WO Pages: 684 Published: 1999

24. Title: [not available] Author(s): HAYNES CV

Source: GEOCHRONOLOGY DESERT Volume: 217 Pages: 627 Published: 1982

25. Title: [not available] Author(s): HAYNES CV

Source: PREHISTORY E SAHARA Pages: 353 Published: 1980

26. Title: [not available] Author(s): PEEL RF

Source: I BRIT GEOGRAPHERS T Volume: 38 Pages: 1 Published: 1966

27. Title: New light on the origin of the Qattara Depression

Author(s): Said, R.

Source: SOC GEOGRAPHIE EGYPT Volume: 33 Pages: 37-44 Published: 1960

28. Title: [not available] Author(s): SQUYRES CH

Source: C PETR EXPL SOC LIB Pages: 99 Published: 1964

29. Title: MULTIPLE PARALLEL-TRUNCATION BEDDING PLANES - A FEATURE OF WIND-DEPOSITED SANDSTONE FORMATIONS

Author(s): STOKES, WL

Source: JOURNAL OF SEDIMENTARY PETROLOGY Volume: 38 Issue: 2 Pages: 510-& Published: 1968

30. Title: CRYSTALLIZATION PRESSURE OF SALTS IN STONE AND CONCRETE

Author(s): WINKLER, EM; SINGER, PC

Source: GEOLOGICAL SOCIETY OF AMERICA BULLETIN Volume: 83 Issue: 11 Pages: 3509-& DOI: 10.1130/0016-7606(1972)83[3509:CPOSIS]2.0.CO;2 Published: 1972 31. Title: [not available]

31. Title: [not available] Author(s): *QATT PROJ AUTH

Source: STUD QATT DEPR DRAFT Published: 1979