المؤتمر العالمي الثالث
للجيوفيزياء الهندسية

Third International Conference
on Engineering Geophysics

15–18 November | Al Ain, UAE

دائرة الشؤون البلدية
DEPARTMENT OF MUNICIPAL AFFAIRS
بلدية مدينة العين
AL AIN CITY MUNICIPALITY

جامعة الإمارات العربية المتحدة
United Arab Emirates University

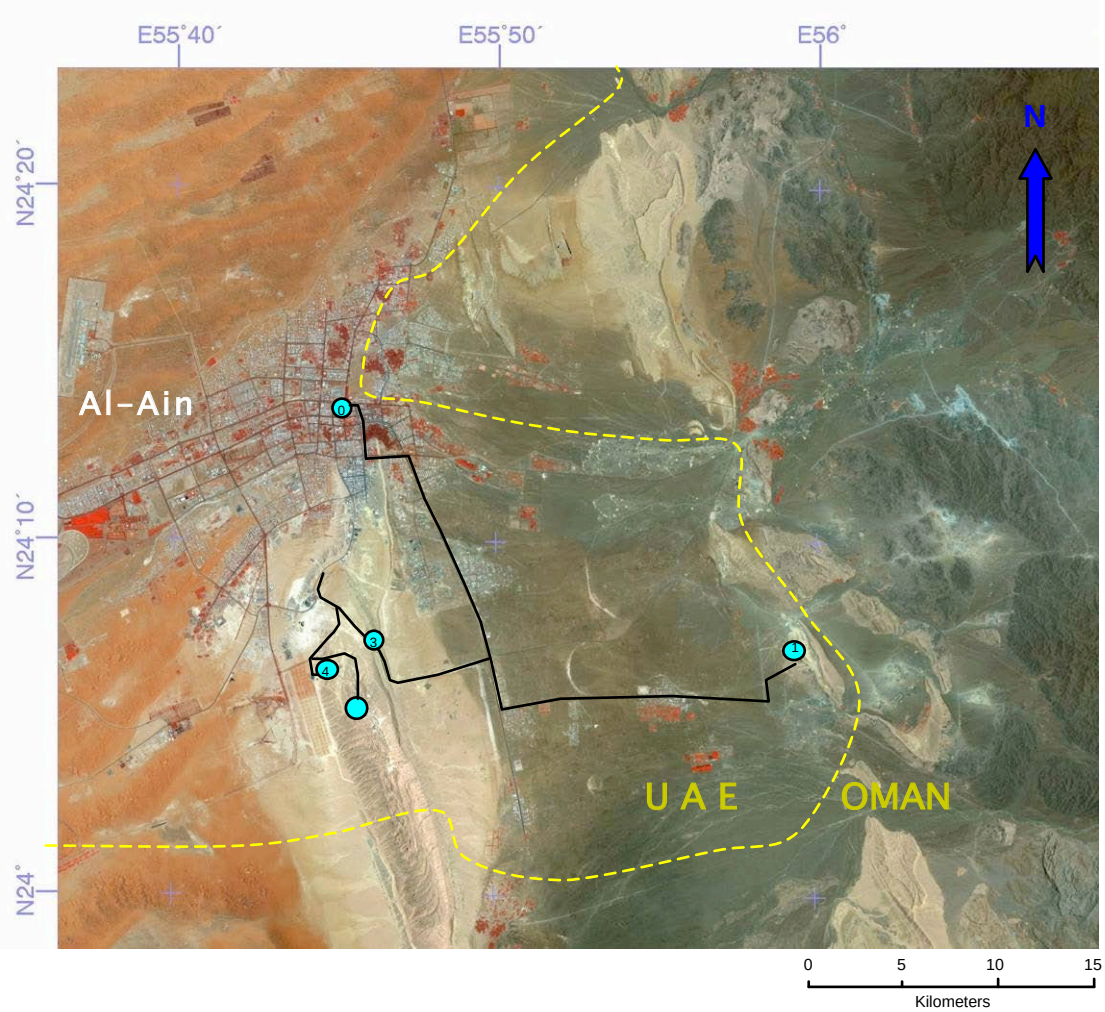
UAEU

SEG

أدنوك
ADNOC
شركة بترول أبوظبي الوطنية

القيادة العامة لشرطة أبوظبي
Abu Dhabi Police GHQ.

FIELD TRIP
ENGINEERING FEATURES OF THE LIMESTONE BEDROCKS OF AL-AIN, UAE



Date of the field tour: Thursday 19th November, 2015

Time: 8:30 a.m. – 3 p.m

Place of Departure:. El Maqam University Campus, Crescent Building

Aspects of the tour: Karstic cavities are common structural features in the limestone basement rocks of Abu Dhabi Emirate, especially in the Dammam and the overlying Asmari Formations in Al-Ain city. These cavities constitute hazards for the stability of building foundations. This tour will visit areas affected by karstic cavitation and also other more recent features of bedrock weathering.

Tour guides: Professor Hasan Arman, Dr. Abdel-Rahman Fowler and Dr. Osman Abdelghany

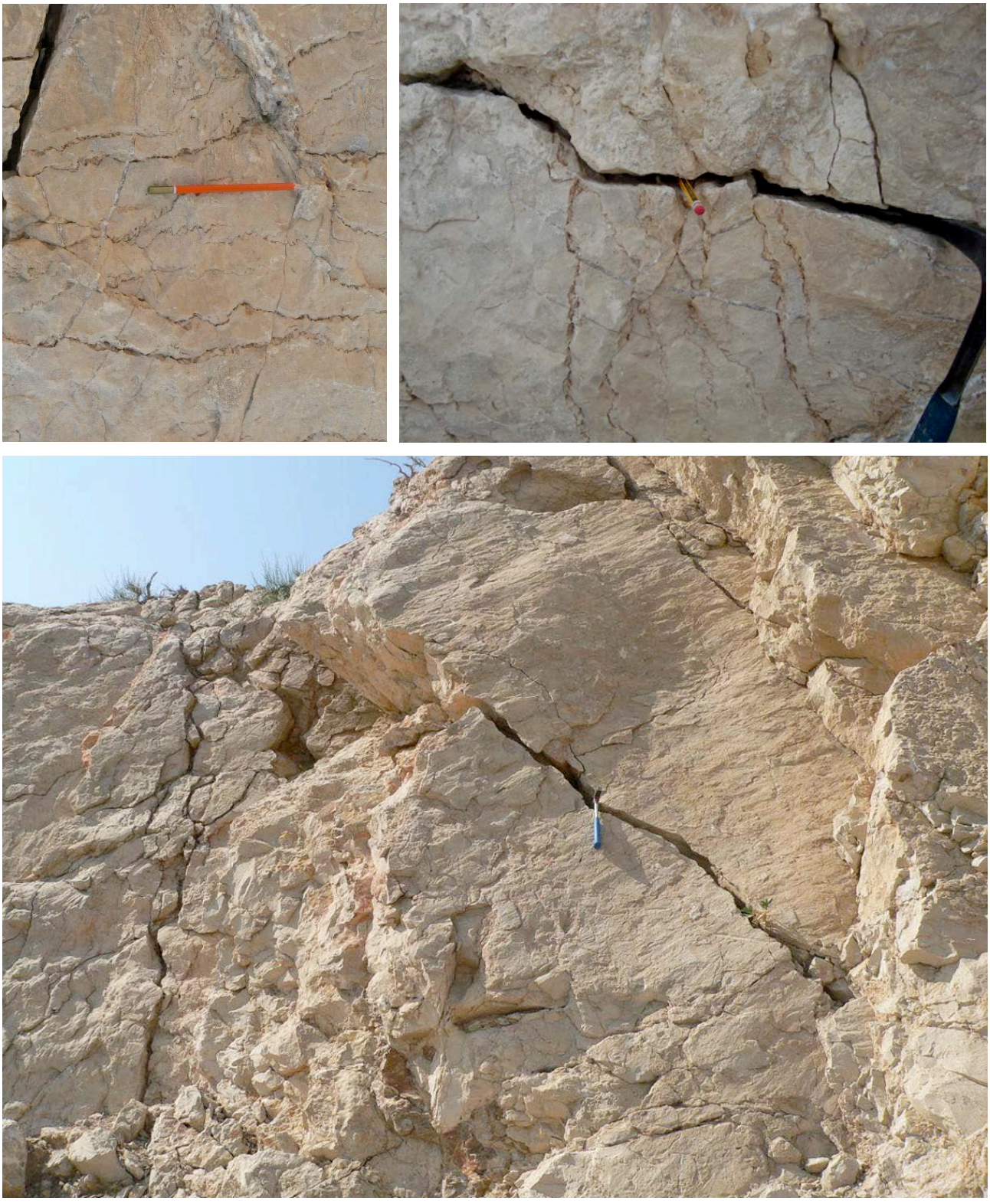
Field tour: Al-Ain Area, Jabal Mundassa, Jabal Hafit

Lunch arrangements: 1:30–2:30 p.m. at the Mercure Hotel, Summit of Jabal Hafit.

TOUR ITINERARY

Stop 1

At Jabal Mundassa we will examine the coarse-grained fossiliferous bioclastic limestones of the Upper Cretaceous Simsima Formation, which have intensely developed fracturing described as stylolitic (dissolution along cracks by stress-increased solubility), veining (calcite healed opened cracks) and faults.



Diversity of fractures in the Simsima Formation at Jabal Mundassa

Stop 2

Sinkholes and other karstic features of the Dammam and Asmari limestone formations will be viewed near Mazyad on the eastern side of Jabal Hafit. In addition, the limestones in this area show recent surface cavitation (honeycomb) weathering related to wind and salt effects in an arid climate. Soluble gypsum/anhydrite is an important component of rocks in the Al-Ain area.

Karst dissolution leading to sinkholes in Asmari limestone

Honeycomb weathering in Dammam and limestone

Gypsum/Anhydrite bed rock

Stop 3

Road cutting along the eastern limb of Jabal Hafit. The beds here are steeply dipping fossiliferous limestones and soft marls of the Middle to Upper Eocene Dammam Formation. There are numerous fault structures and fibrous gypsum veins. The beds here apparently slipped over each other during the folding of the Hafit Anticline.

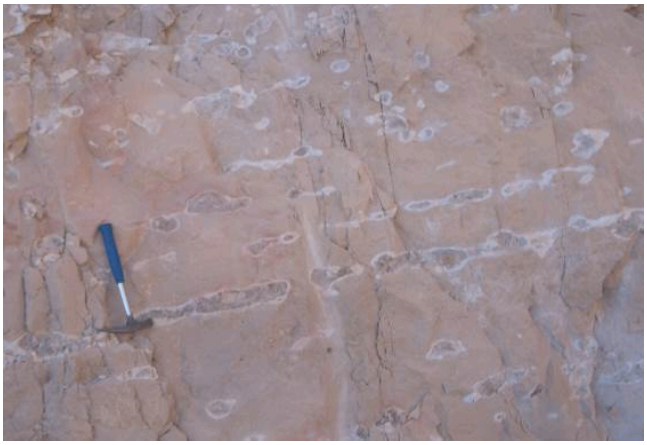
Fault striations

Stop 4

At the Al Mubazara area (foot of Jabal Hafit) we pass through Middle Eocene nummulitic limestones and into the deepest unit in the Hafit Anticline – the Lower Eocene Rus Formation. This formation consists of fine-grained nodular structured limestones and limestones with chert nodules. A major strike-slip fault cuts through Lower-Middle Eocene rocks and may have been a conduit for hot spring waters in the past.

Large white chert nodule in dolomitized Rus Formation limestonet

Dissolution cavities related to dolomitization



Chert nodules parallel to bedding

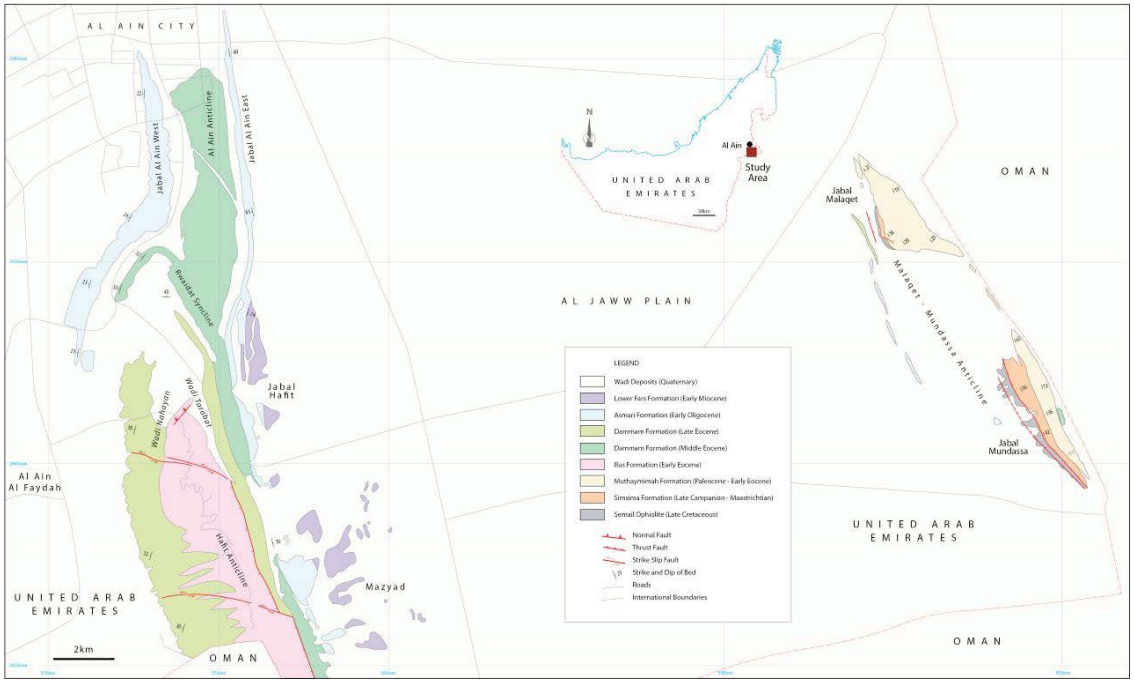
Sparry calcite cavity

GEOLOGY OF AL-AIN AREA

1. Introduction

Al-Ain city is located at the eastern limit of Abu Dhabi Emirate, near the international border with the Sultanate of Oman. Al-Ain and Buraimi together form one of the largest oases in the Arabian Peninsula, due to a plentiful supply of surface and subsurface water draining from the Oman Mountains to the east.

Al-Ain area is surrounded by three main geomorphological provinces (El-Ghawaby and El-Sayed, 1996): 1) Al Jaww piedmont plain of the Oman Mountains to the east, 2) the hilly area where bedrocks crop out to the southeast, and 3) the dune covered scarps to the north and south. Jabal Hafit and other mounts of Al-Ain area form conspicous geological features. For example, Jabals Auha, Huwayyah, Malaqet and Mundassah are foothills of the northern Oman Mountains. Older rocks are exposed in the core of a major anticline running through these mountains, while Jabal Hafit represents the younger sequence of Tertiary age.



Geologic Map of Jabals: Hafit, Malaqet and Mundassa area (modified after Styles et al., 2006)

2. Jabal Hafit

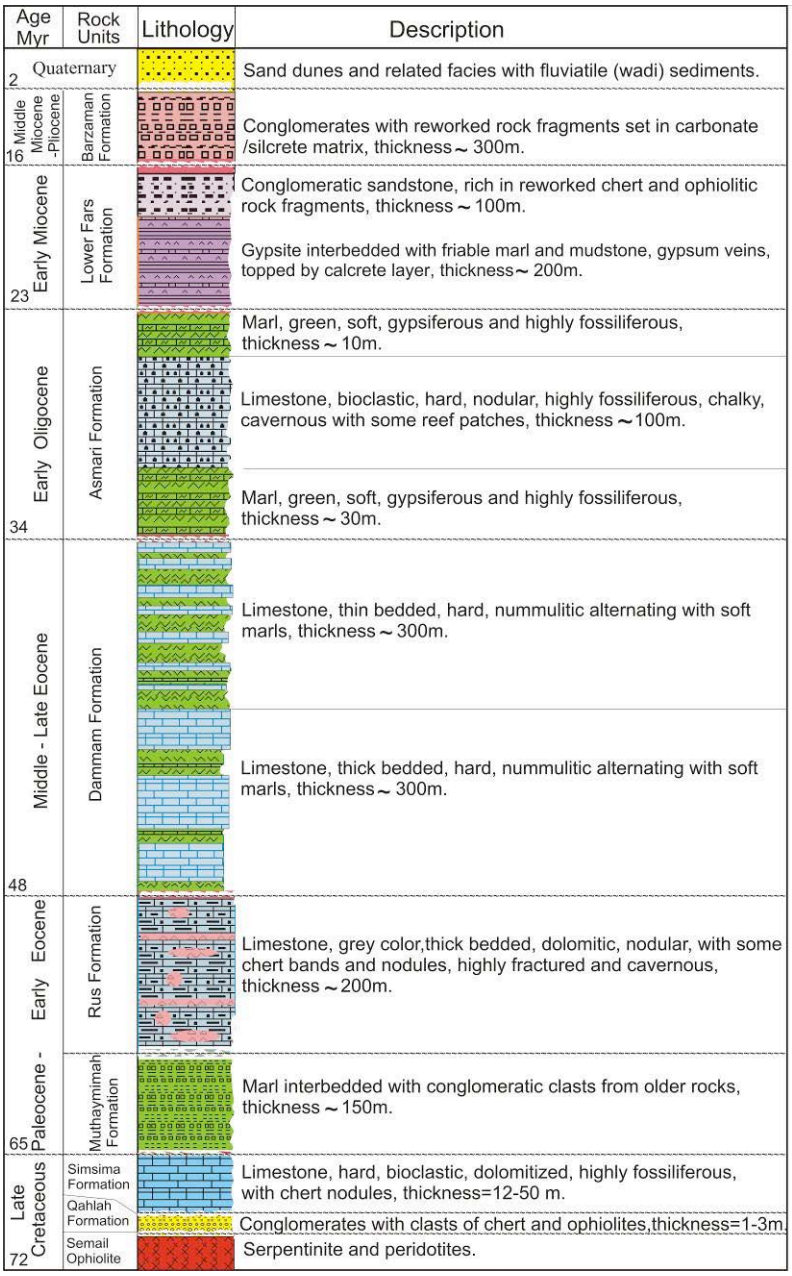
2.1. Location and importance

Jabal Hafit is located to the south-east of Al-Ain city (Lat. 240 02' to 24013' N and Long. 55044' to 55049'E). It is considered as one of the most prominent features of the city. It is bounded to the north by Al-Ain city, to the east by Al-Jaww plain, to the south east by Mazyad, to the south by Oman and to the west by Ain Al Faydah resort and Zakher suburb. Ain Al Faydah is a monumental area nearby Jabal Hafit and located to the west of it. It is believed that the source of its famous hot springs is situated under Jabal Hafit.

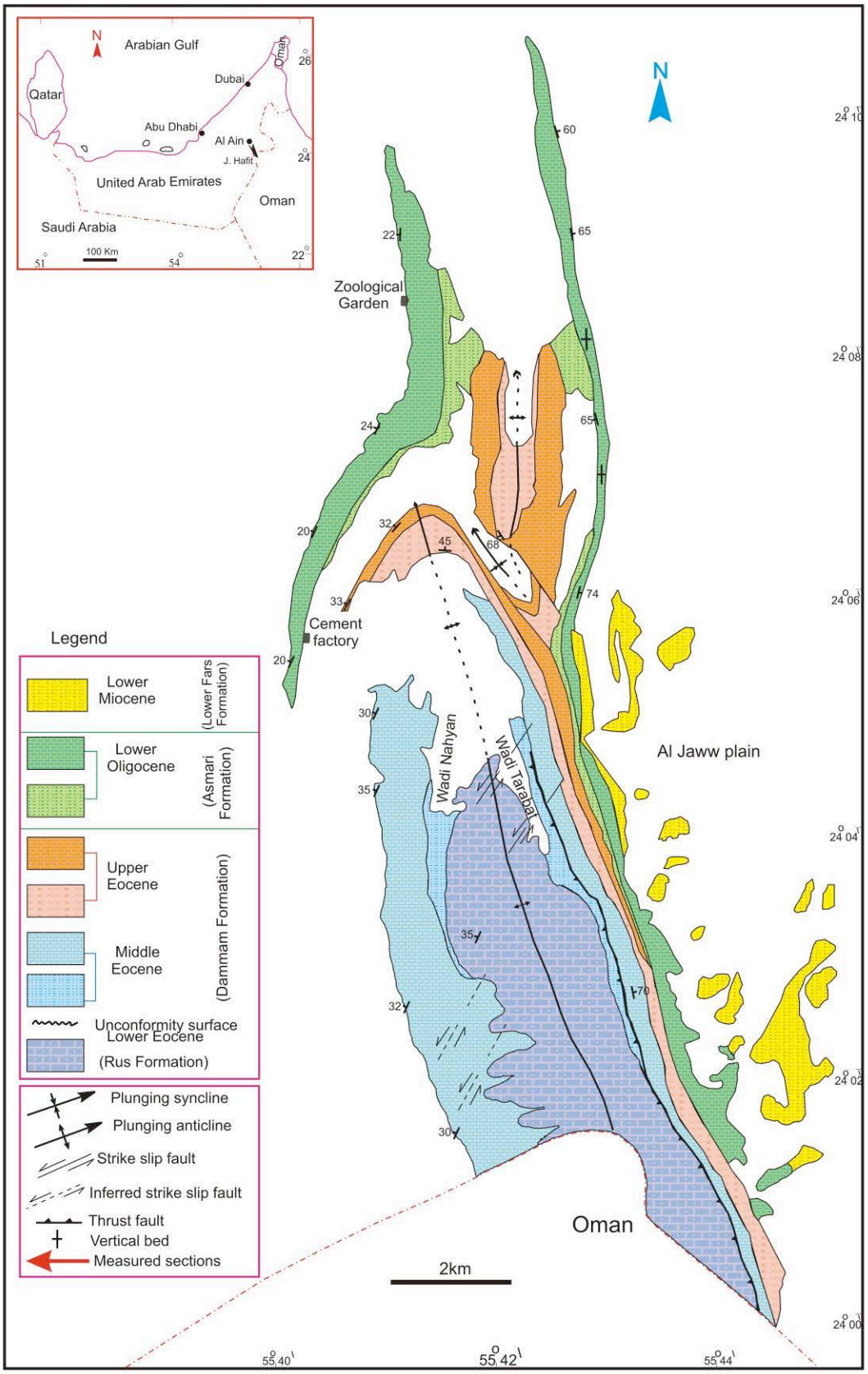
2.2. Geology

Jabal Hafit is about 29 km long, 5 km wide and reaches an elevation of 1240 m above sea level. The mountain has a "whaleback" appearance, with beds moderately to steeply dipping to the east and west on both limbs. Wadis on the flanks of the fold have produced deeply incised steep gul-

lies. The core of the mountain exposes a succession of erosion-resistant limestones and dolomites comprising the Rus Formation. Softer marls dominate the main parts of the overlying Dammam Formation. The deeper erosion of these marls has led to the development of two wadis parallel to the axis of the mountain: Wadi Tarabat to the east and Wadi Al Nahayan to the west. The next overlying formation is the Asmari Formation. This unit crops out as low hills of marls interrupted by sharp ridges of resistant limestone beds. Higher formations are very poorly exposed due to their high content of gypsiferous mudstones.



Simplified stratigraphic section of Jabals: Malaqet - Mundassa and Hafit



Detailed map of Jabal Hafit modified by Abdelghany, 2002.

Geological History of the Al-Ain region

More than 100 million years ago the Arabian Gulf area was occupied by a broad ocean named Neo-Tethys. The partial closing of this ocean produced a low mountain range (paleo-Oman Mountains) that quickly subsided allowing deposition of gravels and shallow marine carbonate rocks composed of calcite and dolomite. These older carbonates were followed in the Eocene by larger thicknesses of younger limestones (with muddy interbeds) that form Jabal Hafit Mountain (about 1240 m above sea level). Later tectonic movements related to collision of Arabia with Iran in the Miocene caused folding of the Eocene limestones. Jabal Hafit itself is a single large fold, and shows many other structures like joints and faults. Hafit Mountain provides a good stratigraphic model for the Eocene and is the best local example of later tectonic structures. From the geologic point of view, but also from the tourism perspective. Abundant attractive fossils can be collected from the limestones, e.g. Nummulites and Assilina, which are similar in size and shape to an Emirates one-dirham coin. These are ancient unicellular organisms. There are also other fossils including echinoids, bivalves, gastropods, bryozoa, corals (solitary and colonial ones) and calcareous red algae. All of these fossils contribute to understanding the geological age and the nature of the marine environments and ancient paleogeography of this area.

Hasan Arman is a Professor at Geology Department, College of Science, United Arab Emirates University since August 2008. He received his undergraduate degree from Hacettepe University, Turkey in 1984 and his Ph.D. degree from University of Arizona, USA in 1992. From 1992 to 1993, he was a Postdoc at the University of Nevada, Reno, USA. Between 1993 and 2008, he was a faculty member at Sakarya University, Civil Engineering Department, Turkey as Assistant and Associated Professor. He became a Professor at the same university in 2006. Dr. Arman has been teaching several different courses in undergraduate and graduate levels related to geology, environment, engineering and energy. His research interests include soil and rock mechanics, environmental geology, environmental degradation, water resources, global warming, climate change, renewable and sustainable energy sources. Dr. Arman's publications have appeared in different peer reviewed journals and he is an editorial board member in several international journals, also acting as a scientific reviewer in many others.

Abdel-Rahman Fowler completed B.Sc. degree in Geology with honors in Mineralogy at Sydney University, 1976. His PhD degree was awarded at the University of New South Wales, Sydney, Australia in 1986 with thesis based on Structural Geology and Tectonics. obtained his Ph.D. He is currently Associate Professor of Structural Geology and Tectonics in the Geology Department at the United Arab Emirates University. Society affiliations include the Geological Society of Australia, International Association of Structural and Tectonic Geologists, Specialist Group in Tectonics and Structural Geology, and Australian Institute of Geoscientists. Dr. Abdel-Rahman is particularly interested in Arabian-Nubian Shield evolution and has published papers in national and international journals on this topic.

Osman Abdelghany he received his B.Sc. in Geology with honors and M.Sc. in Stratigraphy and Micropaleontology from Ain Shams University, Cairo, Egypt respectively. He obtained his Ph.D. in 1996 from Vienna University, Austria. He is currently Associate Professor of Stratigraphy and Micropaleontology at United Arab Emirates University. Society affiliations include the ESG, GSA, GSE, ESP and ENHG. Dr. Osman is particularly interested in Cretaceous/Tertiary stratigraphy and microfossils and published a lot of papers in national and international magazines.