



European Geosciences Union General Assembly 2017, EGU
Division Energy, Resources & Environment, ERE

Thermal impacts of magmatic intrusions: a hypothesis of paleo-heating processes in the Tiberias Basin, Jordan-Dead Sea Transform

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Abstract

Extensive evidence of Ca-rich brine at the western side of Lake Tiberias (LT), Israel, refers to dolomitization processes. Dolomitization of Mg-rich brine saturated limestones preferentially occurs at enhanced temperatures. The presence of wide areas of fissured basalt in that area suggests that magma, which erupted through fissures, sufficiently heated initiating dolomitization. In this study we numerically investigate possible paleo-heating processes related to magmatic intrusions.

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Peer-review under responsibility of the scientific committee of the European Geosciences Union (EGU) General Assembly 2017 – Division Energy, Resources and the Environment (ERE).

Keywords: Lake Tiberias; FEFLOW; thermal field; Tiberias Basin; fault; temperature anomaly

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1. Introduction

The Tiberias Basin (TB) is located within the Jordan–Dead Sea Transform and is bordered to the west by the Lower Galilee (Israel), where fractured Pliocene basalts cover an area of about 1,050 km² (Fig. 1). Hydrochemical analyses highlight that along the western side of Lake Tiberias (LT), brine is Ca-rich, likely due to dolomitization of limestones [1]. Dolomitization of limestones at laboratory conditions is proved at temperatures above 100 °C [2-3]. Numerical models describing [e.g. 4-6] indicate that local fractures or anisotropy can be responsible of the present thermal field within this area. Here we numerically investigate whether high pale- temperatures could have been induced by heating processes related to magmatic intrusions through faults.

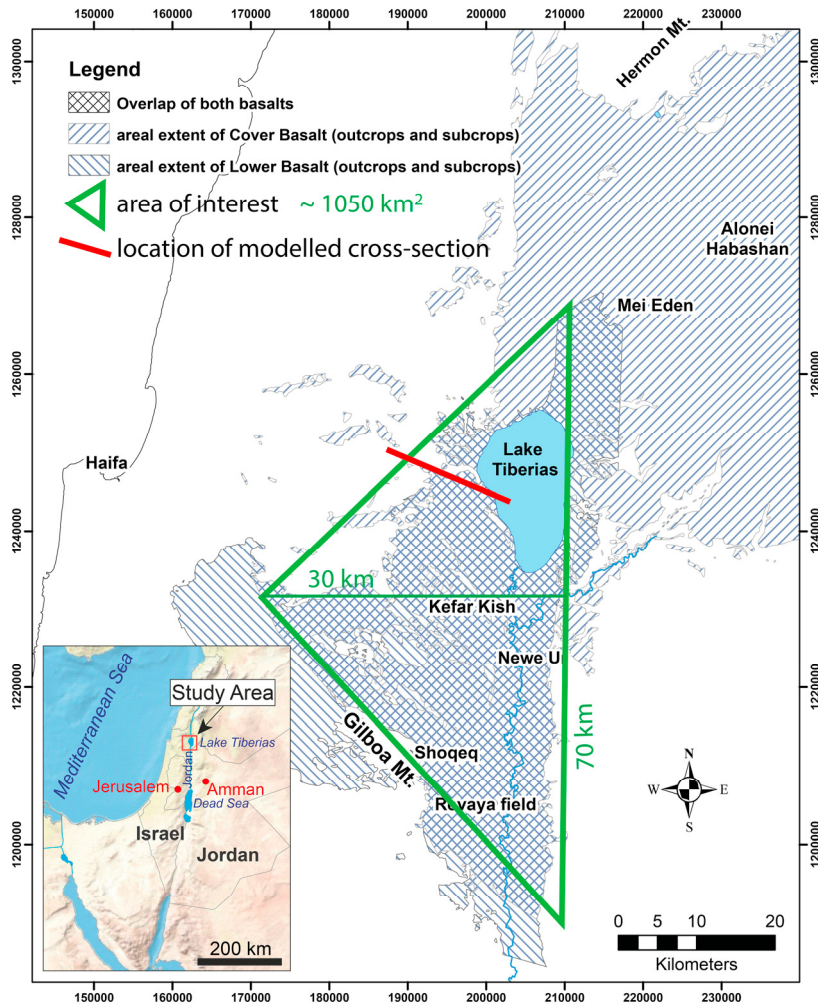


Fig. 1. Map with area of interest, in the green triangle (modified after [7]), location of simulated profile in red. The numerical examples of this article are based on structural features of the Lower Galilee, the profile is W-E oriented.

1.1. Geology of the Lower Galilee

Tortonian (Upper Miocene) Mediterranean transgression invaded the Jordan Rift Valley (JRV) through the lower Galilee and the Jezrael Valley forming an inland sea [8]. This transgression deposited massive salt layers at the JRV and the time equivalent marly Bira Formation rift margins and along the transgression path [9]. Migration of

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