

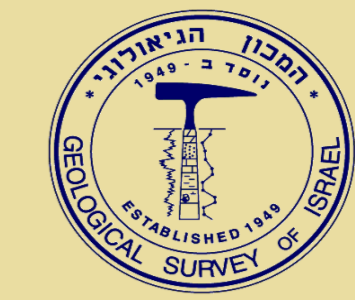
OSL dating of the phreatomagmatic eruptions at Birket Ram maar

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Introduction:

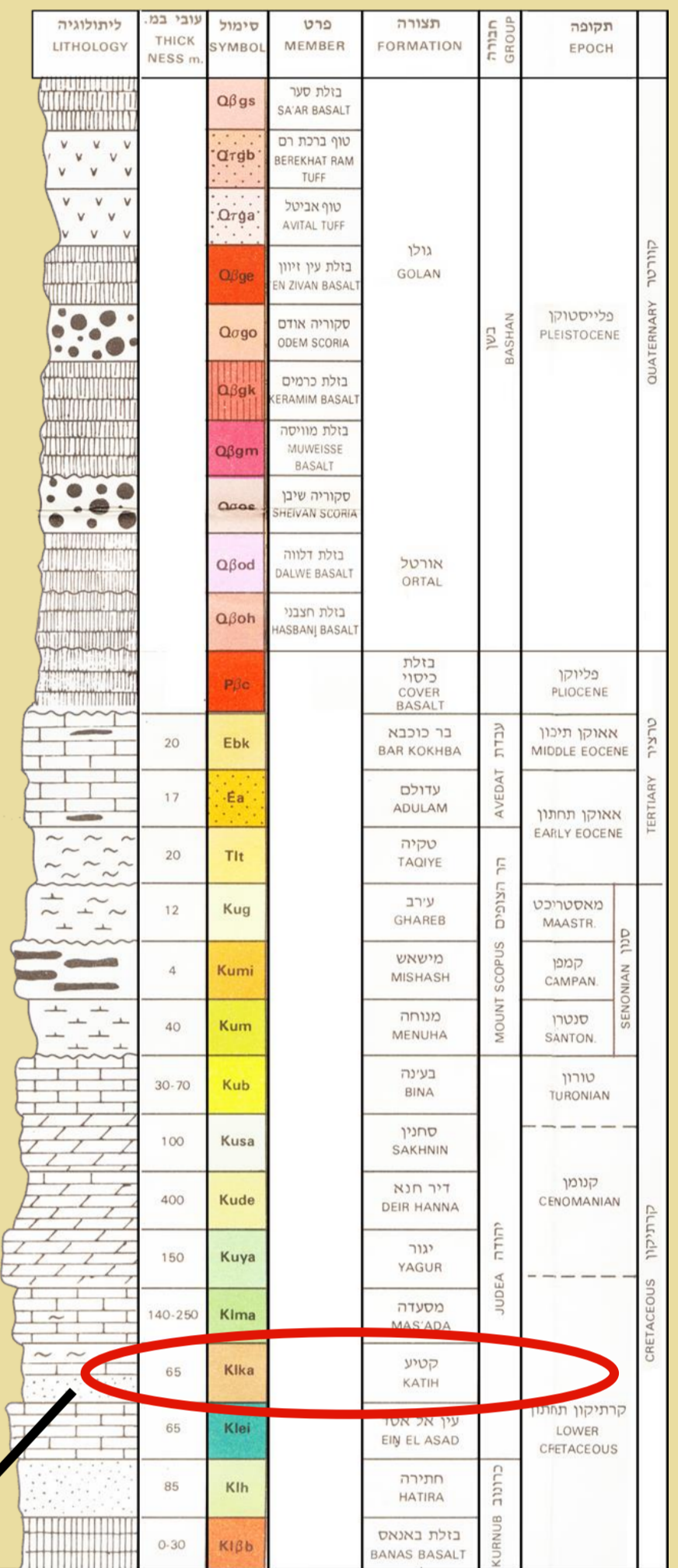
Birket Ram is a maar lake formed by a series of phreatomagmatic eruptions. The maar rim is built by a tuff ring that covers Pleistocene basalts and Upper Cretaceous carbonates and is covered (west of the maar) by another Pleistocene basalt (the Saar Basalt). The tuff is mainly composed of basaltic lithic clasts, but clasts of carbonates and quartz grains from Lower Cretaceous sandstones (at least 320 m deep) are also found. The Paleosols underlying the tuff contain eolian quartz grains.



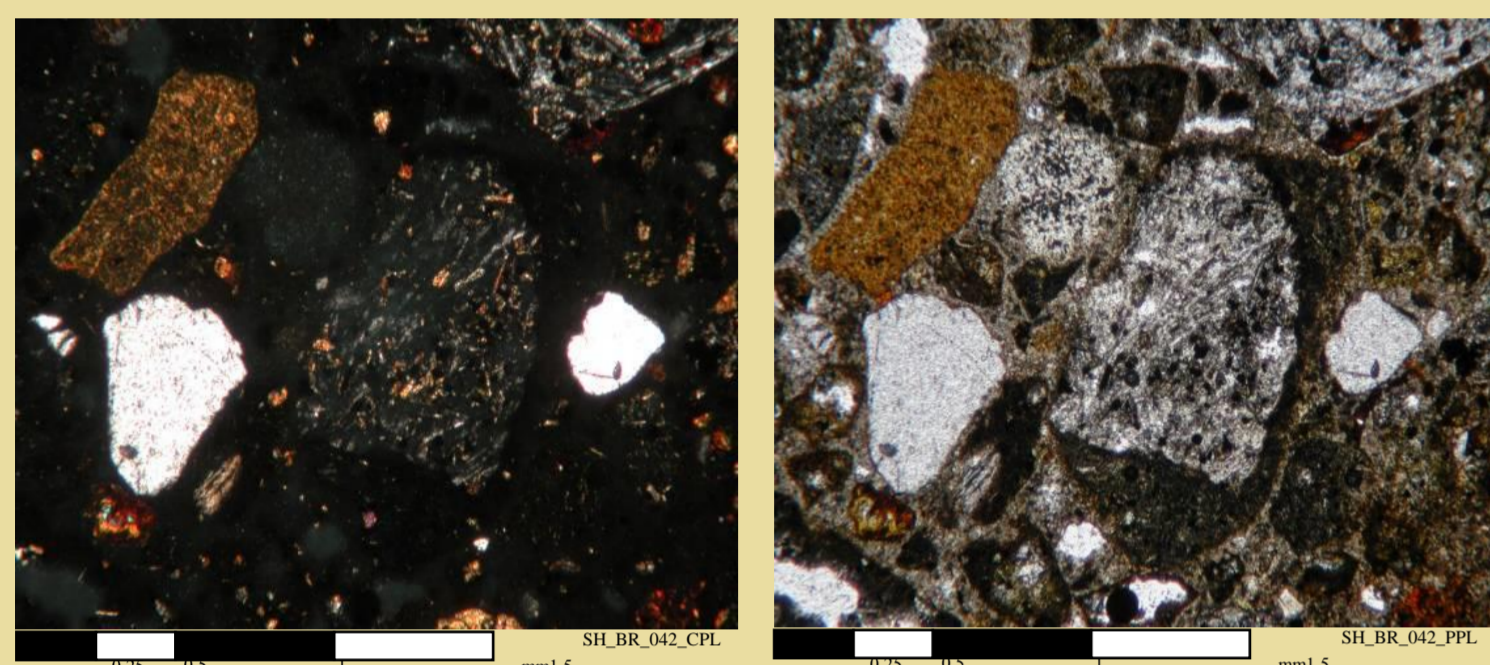
Birket Ram from Mt. Keramim

Optically Stimulated Luminescence (OSL) is a method for measuring the time since the last exposure of quartz or feldspar crystals to heat or sunlight. The age is obtained by measuring the OSL signal that accumulated over time and is emitted by stimulating the crystal with light. The signal is then regenerated using known laboratory doses to determine the "Equivalent dose". The rate of signal growth over time is calculated using in-situ measurements and the concentrations of U, Th and K. The age is calculated from the ratio between the regenerated equivalent dose and the environmental dose rate. During phreatomagmatic eruptions, quartz grains ejected with the tuff are heated. If heating was at a sufficiently high temperature (>400°) and for long enough duration (several minutes), then the OSL signal may reset. This allows for the dating of phreatomagmatic eruptions by OSL.

Stratigraphic Chart



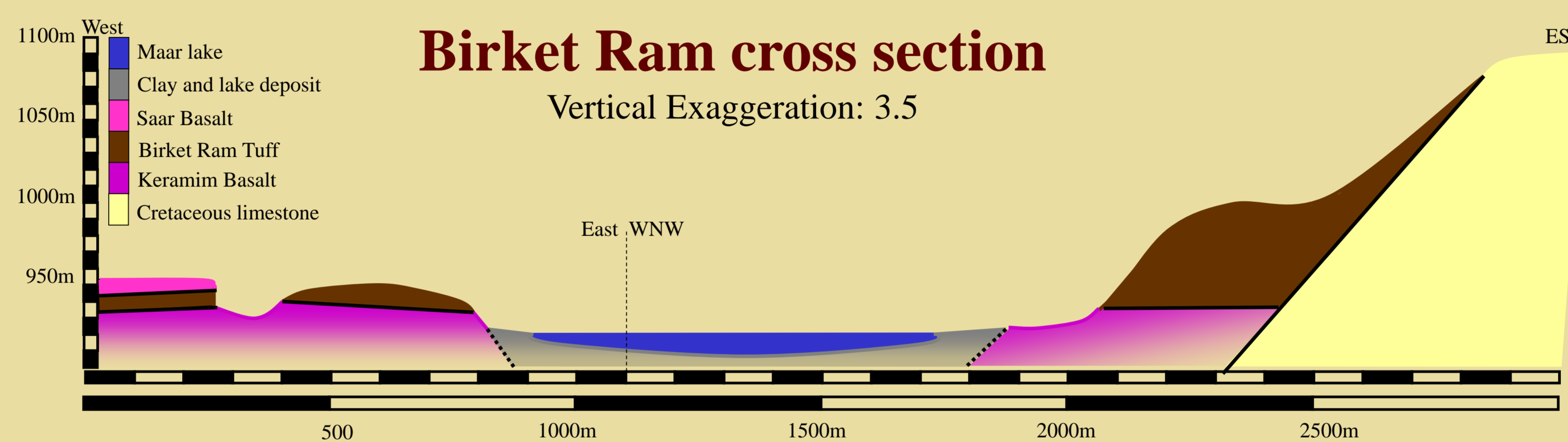
The Quartz fragments in the tuff are from the Lower Cretaceous sandstone.



Quartz Grains in a tuff thin section (left – CPL, right – PPL)

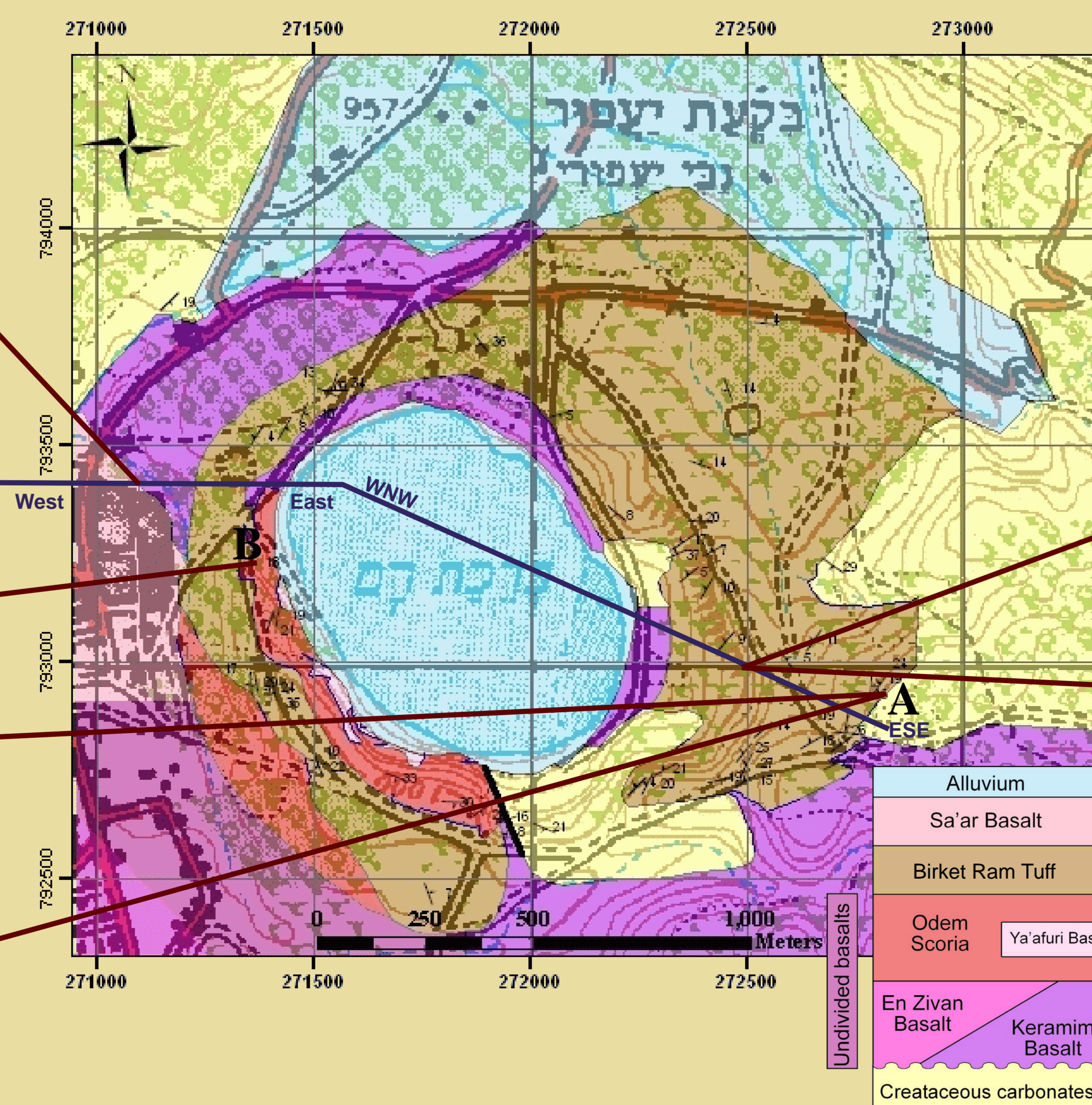
Previous dating works:

Keramim Basalt is breached by the phreatomagmatic eruptions and covered by the tuff. It was Ar-Ar dated by Goren-Inbar (1985) at 233 ± 3 Ka, thus setting a lower boundary for the maar formation. An upper boundary was set by extrapolating radiocarbon ages of cored lake sediments and obtaining an 108 ka age for the lowest lake sediment. (Ehrlich and Singer 1976)



Calcareous paleosol underlain the tuff

Geological map of Birket Ram 1:5,000



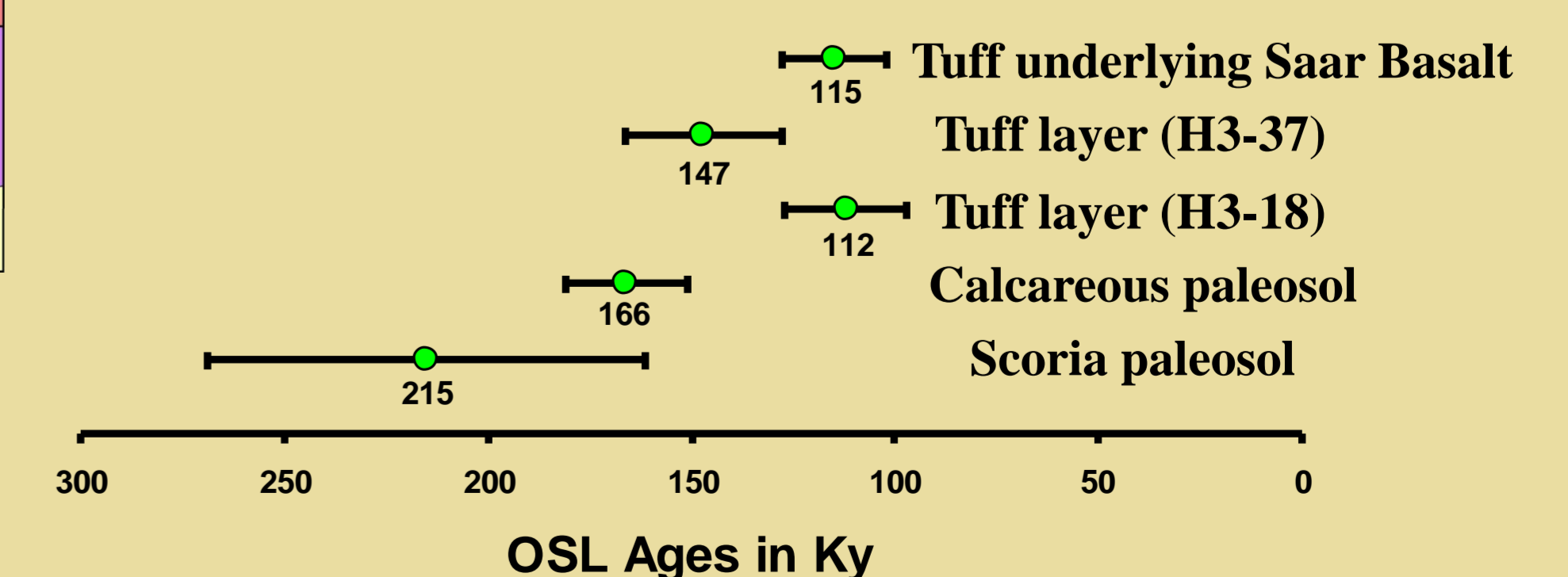
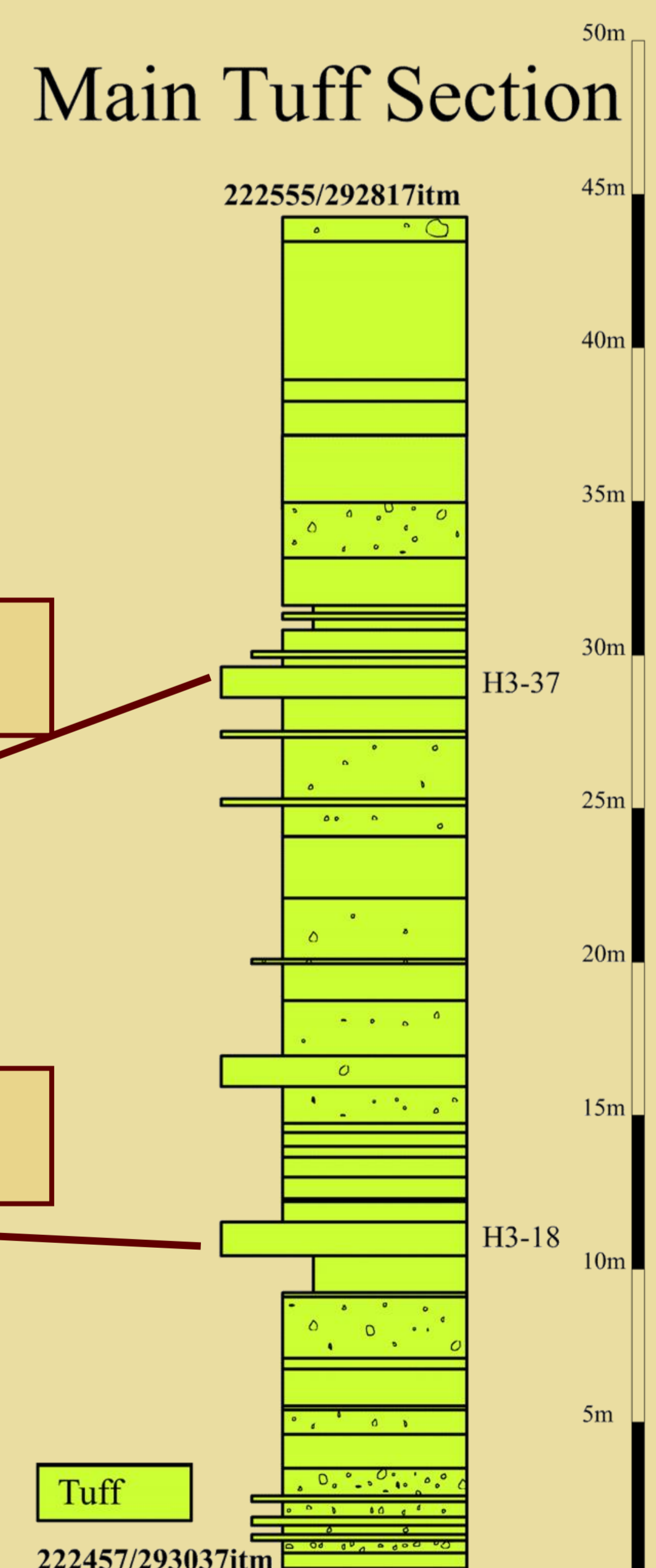
Birket Ram Cross Section

Quartz grains in the uppermost tuff layer, directly underlying a flow of Saar basalt, yielded an age of 115 ± 13 ka. The age is interpreted as a thermal resetting of the quartz by the flow.

Two paleosols underlying the tuff, one overlying limestone (A) and the other one overlying scoria (B), yielded ages of 166 ± 15 ka, and 215 ± 54 ka, respectively.

Tuff layer, above the calcareous paleosol yielded an incompatible and inconclusive age of 332 ± 44 ka. Most probably the OSL signal was not fully reset by heat during the eruption.

Main Tuff Section



Summary and Conclusions: Since no paleosols were found in the tuff succession, we assume that the phreatomagmatic eruptions at Birket Ram occurred continuously within a short period of time (e.g. months or less), as is usually the case in maar eruptions. We take the younger age found amongst the paleosols underlying the tuff (166 ± 15 ka) as a maximum age for the tuff emplacement and the tuff sample reset by Saar Basalt (115 ± 13 ka) as a minimal age of the phreatomagmatic eruptions.

This data is in agreement with Previous dating works [Ref.] but narrows the time window for the phreatomagmatic eruption (180 ka to 100 ka).

Reference:

- Ehrlich A., Singer A., 1976. Late Pleistocene Diatom Succession in a Sediment Core from Birket Ram, Golan Heights. Isr. J. Earth sci. 25, 138-151.
- Goren-Inbar N., 1985. The lithic assemblage of the Berekhat Ram Acheulian site, Golan Heights. Paleorient. 11, 7-28.
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