

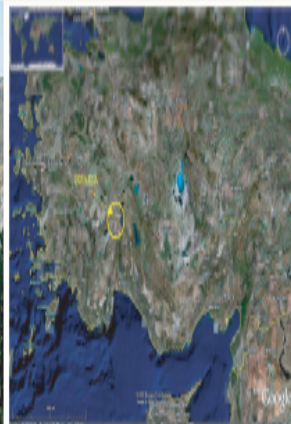
Pleistocene explosive activity of the Gölcük volcano, Isparta Angle, Turkey.



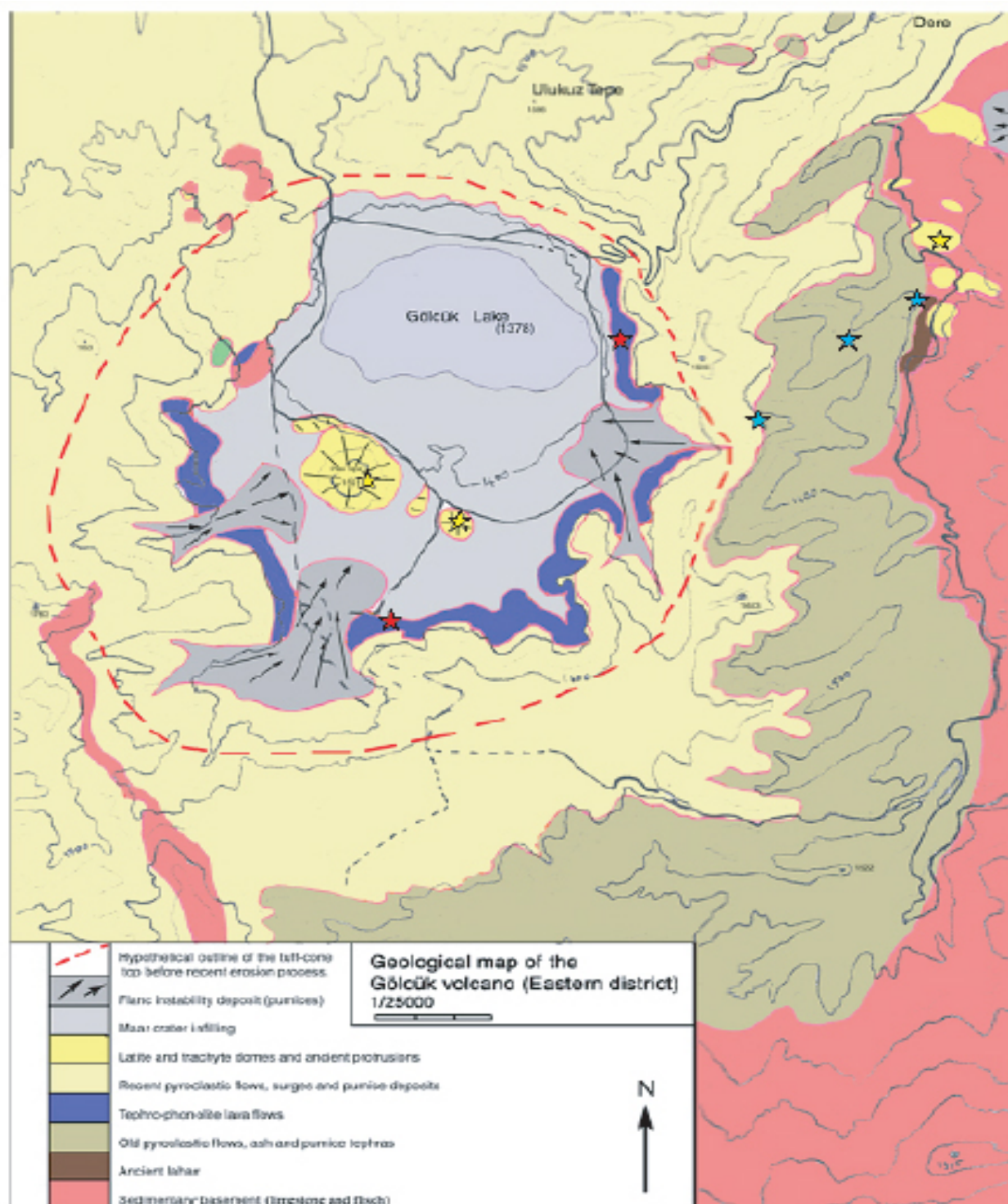
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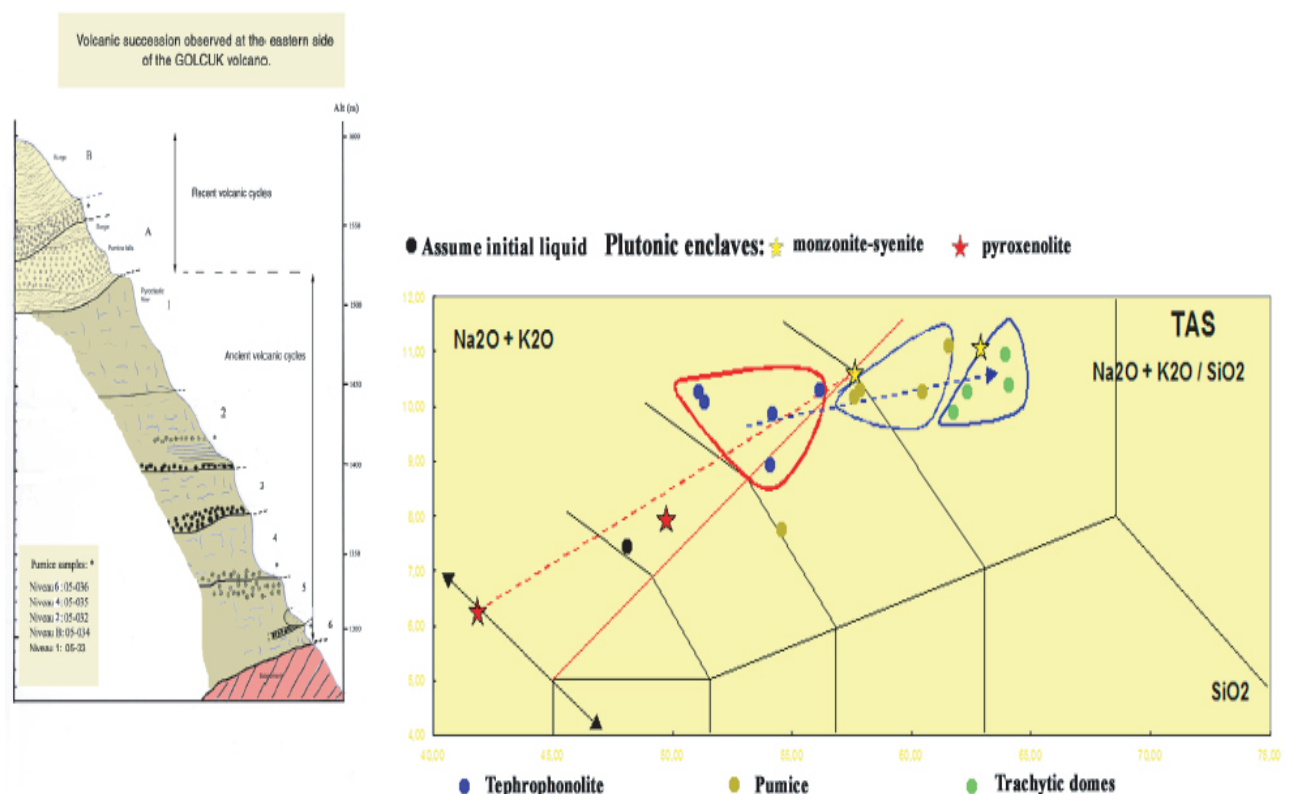
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The Gölcük volcano is built up on superposed limestone and flysch thrust sheets and eroded Pliocene volcanic formations (dykes, domes, lahar...). The Isparta volcanism belongs to the post-collisional alkali potassic-ultrapotassic magmatism (2, 3) that occurs between Afyon and Antalya from North to South. Previous $^{40}\text{K}/^{40}\text{Ar}$ dating was performed (1) on lavas and showed that the potassic-ultrapotassic magmatism occurred between 4.7 to 4 My. However, the recent and probably Quaternary activities of Gölcük volcano has never been dated precisely and its age remains controversial (6). In the so-called Isparta Angle the magmatism is contemporaneous with an extensional tectonic process operative from late Miocene, to Pliocene and Quaternary.



The volcanic series is alkaline potassic, the less evolved lavas are strongly silica-undersaturated tephriphonolite. The pumices from pyroclastic deposits evolve from trachy-andesitic to trachyte compositions they are slightly silica-undersaturated or —oversaturated. The last dome are trachytic. The trend can be the result of mixing between batches of magma and fractionation from a primitive lamprophyric parental liquid. Numerous plutonic enclaves of mica-rich pyroxenolites, mafic syenite (shonkinite type) and felsic monzonite-syenite types have been tapped to the surface from a shallow reservoir where differentiation process takes place (2, 5, 7).



Methods and Measures

Two dating methods were used. The classic $^{40}\text{K}/^{40}\text{Ar}$ dating on mesostasis was performed on lavas : tephriphonolites and trachytic domes. This method is not operative suited for tephtras which form 90% of the eruptive products of Gölcük.

The tephtras have been dated using the single-crystal $^{40}\text{Ar}/^{39}\text{Ar}$ method. Extraction and isotopic analyses of gas have been done by laser-melting of single alkali feldspar crystals (about 30 crystals per sample of porphyritic pumice pyroclasts of pyroclastic flow and pumice fall deposits) using a high-sensitivity noble-gas mass -spectrometer MAP 215* at the B.G.C..

Age-population of laser-melted crystals are very homogeneous or very heterogeneous depending of mixing between juvenile crystals (dating the event) and reworked old crystals: for samples pumice 05-034, 05-036.

When the age-population is relatively continuous (pumice 05-30), the probability maximum for the crystal population is assumed to give the best age estimate of the volcanic event.

Bimodal age-populations, like for sample 05-032, illustrate the mixing between juvenile pyroclasts and remobilised old and cold pumice lithoclasts during the blast and the pyroclastic rush. The older crystals from lithoclast remain enough cold to prevent their degassing and loss of radiogenic Ar.

The $^{40}\text{Ar}/^{39}\text{Ar}$ dating method on single crystal is very useful to permit resolution of the juvenile crystals and the age of the eruption, from the older contaminating crystals.

The 1st and the 5th pyroclastic deposits

relative probability between: 206.1 ± 9.8 ka and 173.0 ± 7.4 ka

Pumice fall from the tuff-ring and pumice fall near Isparta:

relative probability between: 72.7 ± 4.7 ka to 53.5 ± 2.7 ka

Tephriphonolite lavas: between 115 ± 3 ka to 62 ± 2 ka

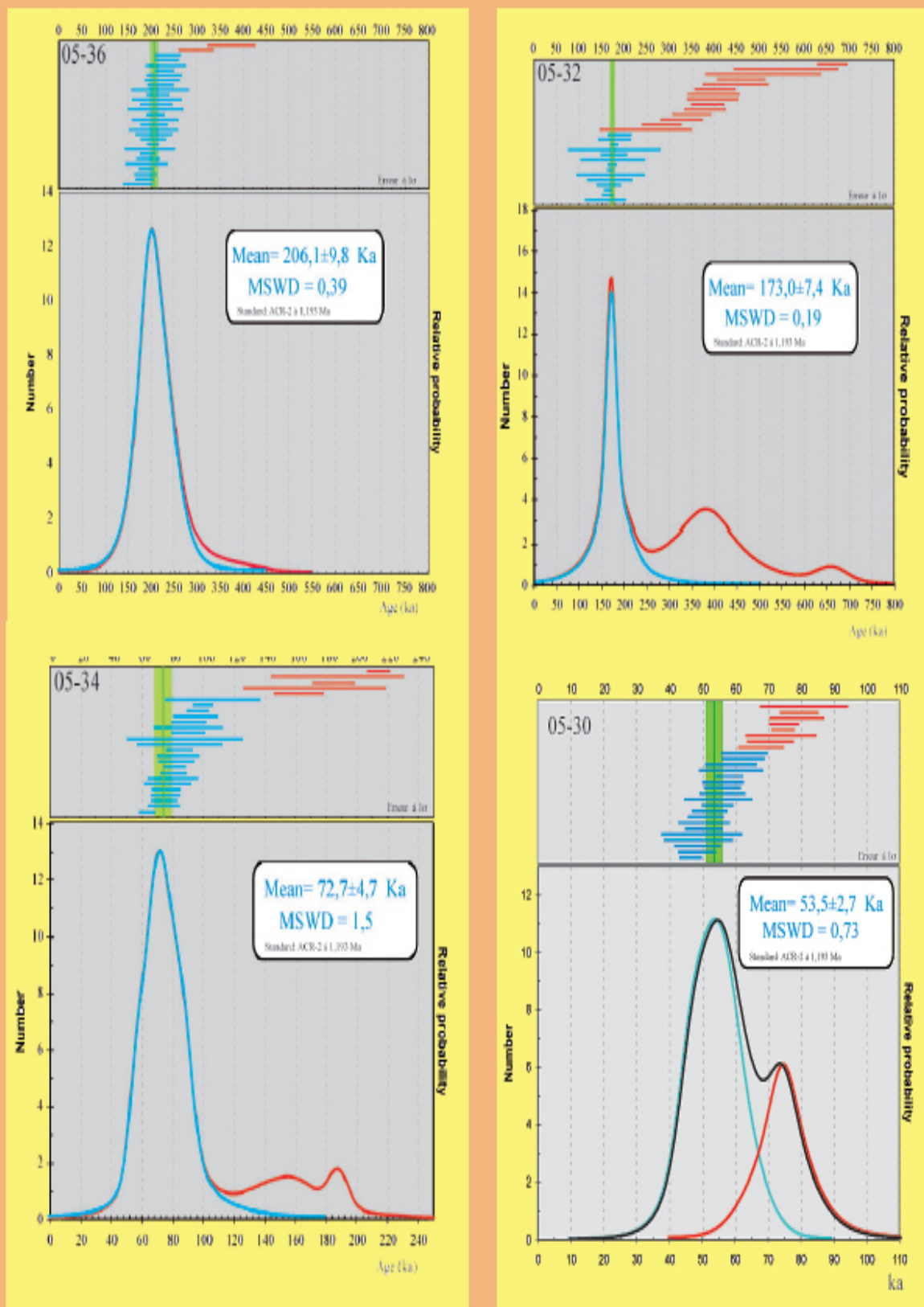
Last trachytic domes: two events : 52 ± 2 ka and 24 ± 2 ka

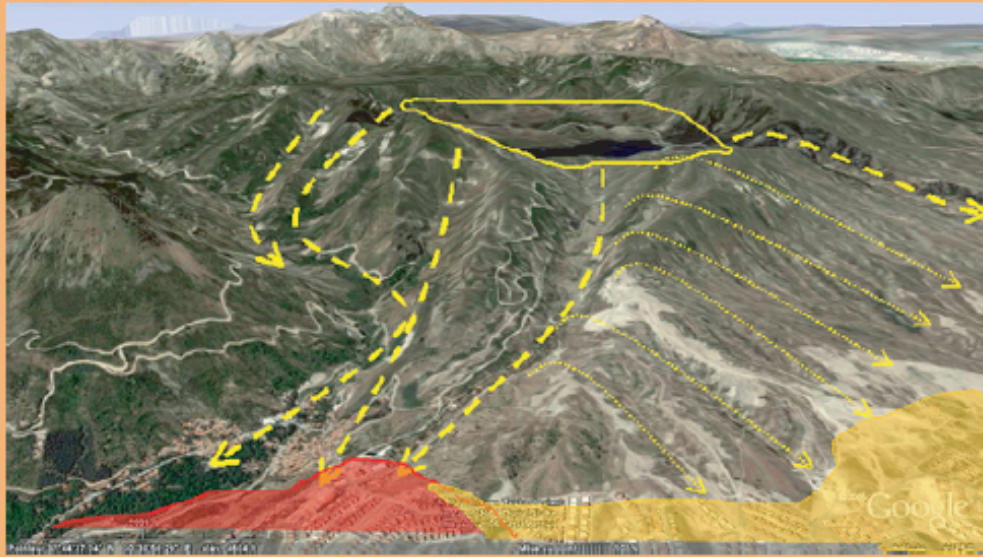
the first age fit well with the age obtained on pumice fall in Isparta area

K-Ar ages of samples from the Gölcük. Results of K/Ar method on lavas
Age calculations are based on the decay and abundance constants from Steiger and Jäger (1977).

Sample ID	Experiment #	Weight mollen (g)	K* (wt.%)	$^{40}\text{Ar}^*$ (%)	$^{40}\text{Ar}^*$ (10^{-13} mol/g)	$^{40}\text{Ar}^*$ weighted mean ($\pm 1\sigma$)	Age $\pm 2\sigma$ ka
005-14	7208	0.90213	4.674 ± 0.047	1.327	1.753 ± 0.123		
005-14	7272	1.47871	"	1.740	1.990 ± 0.064	1.939 ± 0.057	24 ± 2
005-12	7197	0.96924	4.724 ± 0.047	6.503	4.133 ± 0.125		
005-12	7212	1.36758	"	10.143	4.283 ± 0.085	4.251 ± 0.058	52 ± 2
005-11	7160	1.02303	5.230 ± 0.052	1.287	5.805 ± 0.118		
005-11	7192	1.03662	"	1.061	5.403 ± 0.117	5.603 ± 0.083	62 ± 2
005-08	7159	0.99451	5.819 ± 0.058	11.722	11.858 ± 0.013		
005-08	7175	1.06733	"	10.411	11.563 ± 0.013	11.605 ± 0.009	115 ± 3

Results of single-crystal $^{40}\text{Ar}/^{39}\text{Ar}$ method on tephras





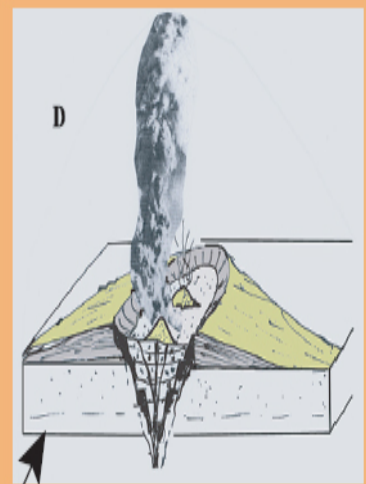
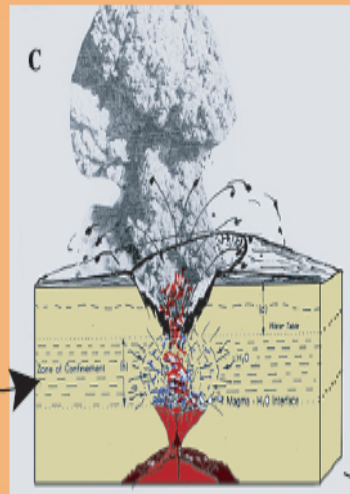
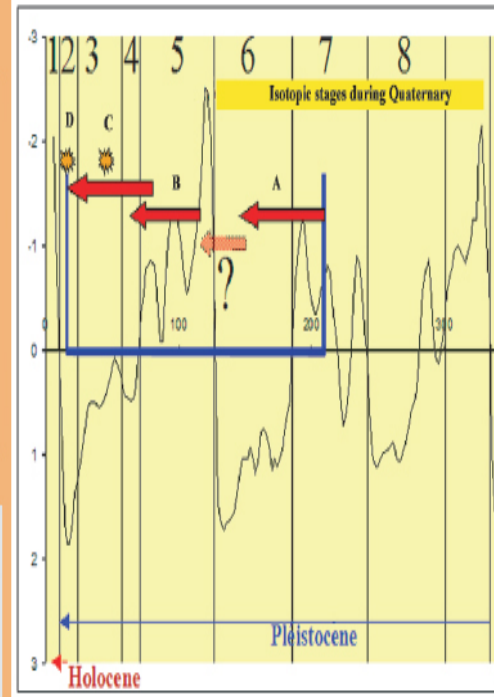
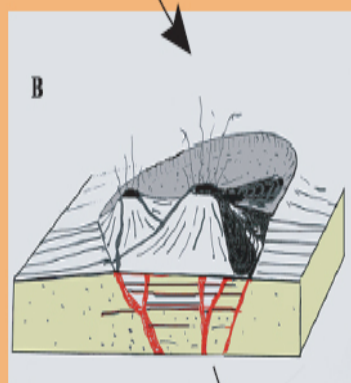
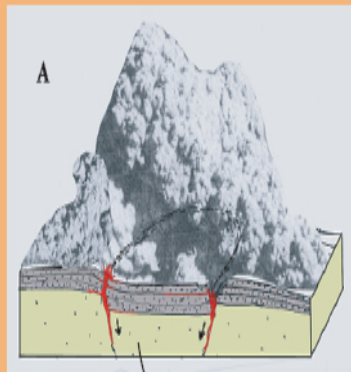
VOLCANIC HAZARD

The periodicity of eruptive processes of Gölçük volcano appears to be long; major crisis are probably separated by several thousands years. Presently, the volcanic history of this explosive volcano appears to be not closed. The major valleys actually opened on the northern flank of the volcano are potential channelways for future pyroclastic flows. New pyroclastic surges will also sweep out this flank leading directly to Isparta.

Acknowledgements are due to Paul Renne (Berkeley Geochronology Center) who let us use the $^{39}\text{Ar}/^{40}\text{Ar}$ facilities of his laboratory.

references

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200 000 years of Gölcük activity

The entire activity of Gölcük volcano takes place during Pleistocene and is disconnected from the older (Pliocene) volcanism. It can be considered as a new volcanic period starting with a major regional event lasting about 50 000 years (minimum) with a minimum of 6 explosive episodes relatively spaced in time.

A first event consisting of lava dome, flows and dykes: this lava episode occurred between 115 to 62 ka with probably some tephra deposit at the bottom of the tuff-ring.

The ensuing tuff-ring formed from 72 ka to 24 ka, the volcano is a maar, the phreatoplinian eruptions have almost entirely destroyed the previous lava flows and dome, this last cycle ending by trachytic dome extrusions. There are several volcanic crisis with relative long time of quiescence as illustrated by the two domes extrusions separated by about 30 kyrs. The volcanic history of Gölcük seems presently interrupted since a minimum of 22 ka.