



High Natural Background Radiation Terrains, Geology And Public Health In Israel And Adjacent Countries

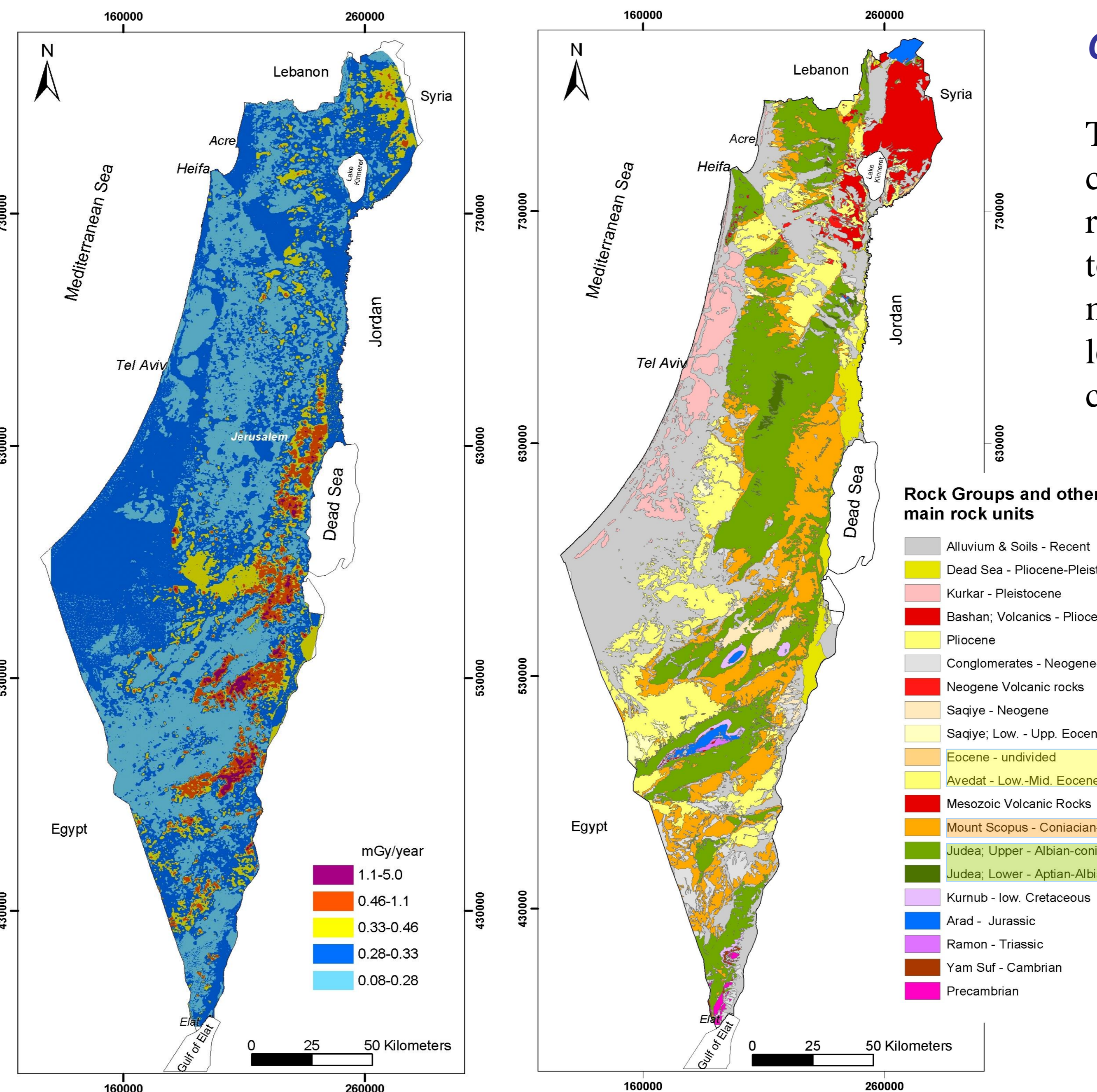


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Dedicated to Dr. Uzi Vulcan – colleague and friend – 1938-1999

Natural terrestrial dose-rate map of Israel

The map is based on an airborne radiometric survey and complementary ground measurements. The airborne system included NaI crystals (40 liters) measuring terrestrial gamma radiation and a 0.4 liter crystal which measured the contributions of cosmic radiation and radon in the air. Four channels were measured – thorium (2.62 MeV resulting from 81Tl), uranium (1.76 MeV; 214Bi); potassium (1.46 MeV; 40K) and total count (0.3-3.0 MeV). Flight altitude was 400 m above ground, and the flight paths were perpendicular to geological structures, which the dominating are trending from SW to NE. The flight lines were spaced 1 Km apart and every 5 Km a right angled control path was carried out. The ground measurements, taken at 1 m above the surface, were made by an Automess Scintomat device. Data processing has been carried out using ARC-GIS.



Geology of Israel

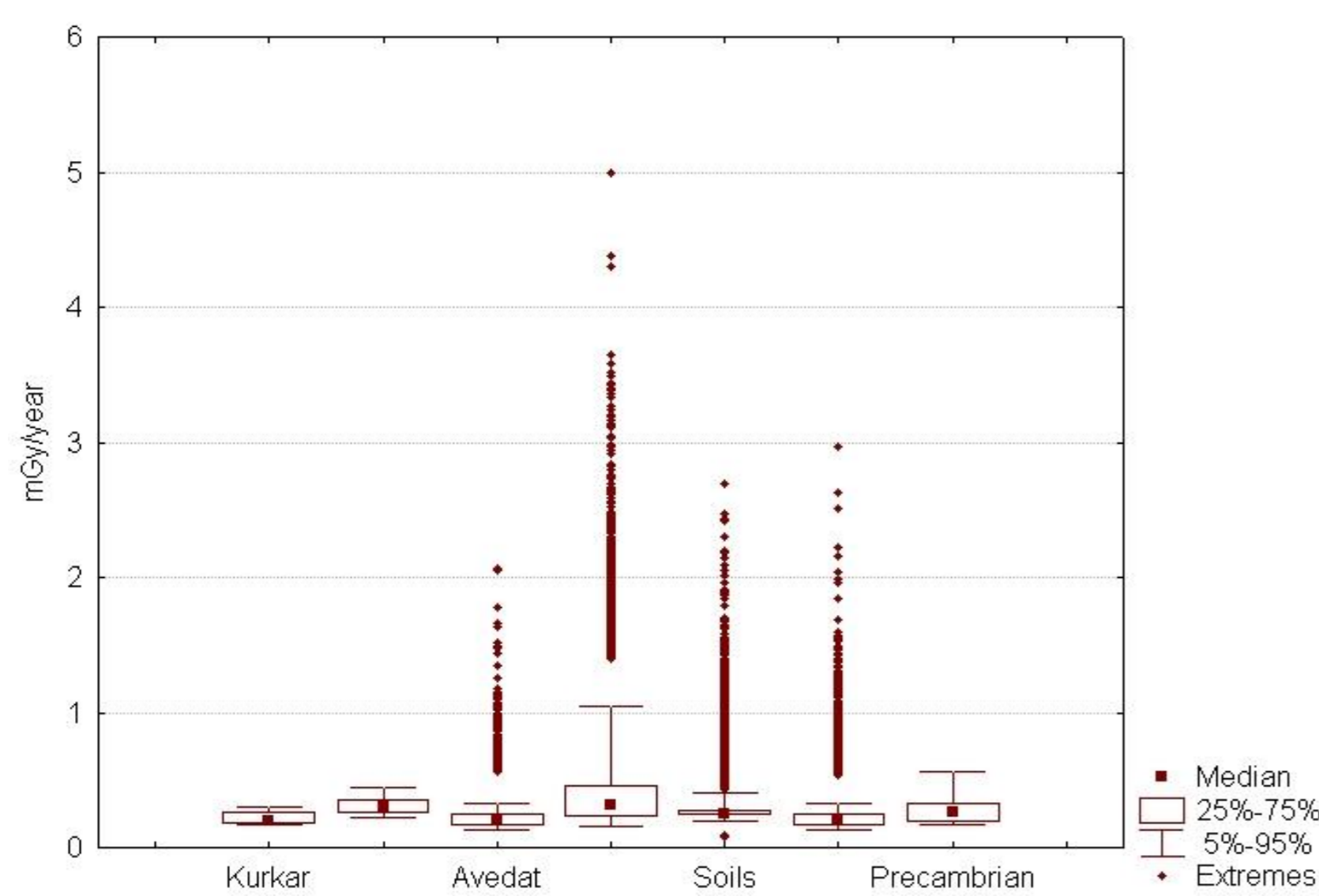
The exposed rock sequence in Israel consists mainly of sedimentary rocks, ranging in age from Paleozoic sandstones up to recent soils. A generalized map of the main rock units in Israel is shown on the left. The lion-share of the exposures is comprised of three rock groups:

Thick sequence of chalks, limestones, and cherts.

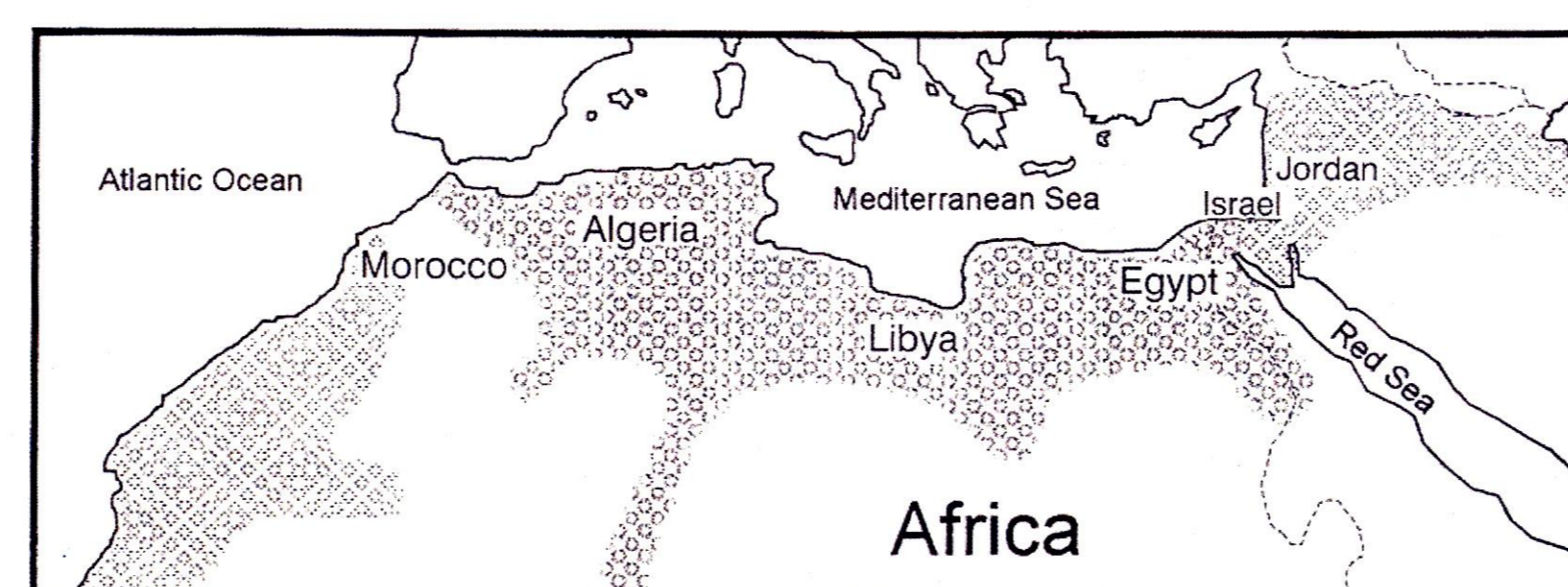
Characterized by a wide transgression of a nutrient-rich sea, which deposited chalks with a high content of phosphate. It consists of alternating chalks and cherts, in many places including economic phosphorite layers.

Limestones, dolomites, chalks and marls, usually without clastic components. The Judea Group covers large parts of Israel and builds the main core of the anticlinal structures. Some Cenomanian tuffs and basalts are found in the Mount Carmel area.

Results



Dose-rate results for some selected rock units, presented as box-plots

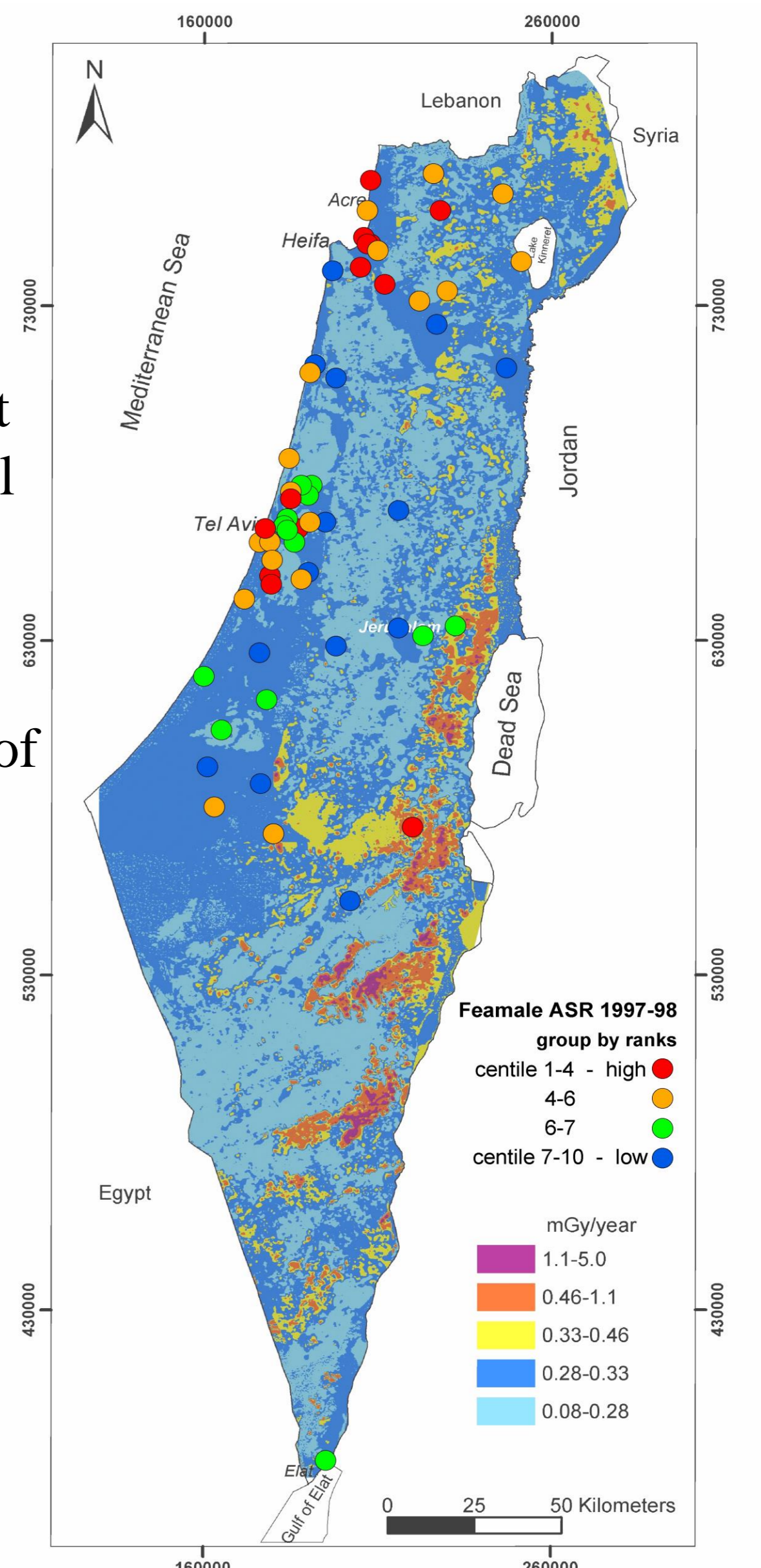


Maximal extent of the Thetian Phosphorite Belt

The average dose-rate for the entire area of Israel is 0.28 mGy/year; the dose-rate for some 20% of the area ranges between 0.47 (95 percentile) and 5.1 mGy/year (maximum). The most high natural background radiation terrains (1-5.1 mGy/year) cover some 10% of the area, in which mainly the rocks of the Mount Scopus Group are exposed. This Senonian-Paleocene-aged group is characterized by phosphorite layers with appreciable amounts (90-150 ppm) of uranium [4]. Thus, the main contribution of radiation in these terrains is that of the uranium series. Elevated radiation levels – up to 3.0 mGy/year - in other areas are due to higher concentrations of thorium and potassium in rich soils and outcrops of young basalts in central and northern Israel. The igneous Precambrian rock units in the southern-most part of Israel also present some elevated dose-rates.

The rocks which compose the Mount Scopus Group are widely spread all over the eastern and southern Mediterranean region, from Morocco to Jordan, forming the Thetian Phosphorite Belt. In most cases, the outcrops are located in desert areas, creating different potential radiation hazards related to public health: in Israel, only few built-up areas are located in these areas, but In Jordan, some of the most populated areas are built on rocks equivalent to the Mount Scopus Group (i.e.: Amman, capital of Jordan), where traditionally a large portion of the dwellings are located at ground level.

A GIS analysis of data published by the Israeli Cancer Registry did not reveal any correlation between the geographic distribution of malignant diseases and high natural background radiation terrains or high radon levels. The explanatory factors for the diversity of malignancy in Israel are urban and industrial, as well as income rates of individuals.



Geographic distribution of malignant diseases (females) in Israel, during the period 1997-1999. The data presented is standardized to the "World Population" (ASR).

References

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