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Swiss National Committee for the International Geodynamics Project
Working Group 11: Magnetism of the Earth

A New Geomagnetic Survey and Geoelectric Soundings in Switzerland

Report by *G. Fischer** and *P.-A. Schnegg**

By coincidence the research effort in geomagnetism at the Observatoire Cantonal of Neuchâtel was started at the onset of the IGP (International Geodynamics Project), in 1971. The Working Group set itself essentially two goals: (1) to carry out a new geomagnetic survey of Switzerland, and (2) to initiate a programme of geoelectric soundings by the magnetotelluric and inductive techniques, in order to participate in a joint survey of the ground resistivities of the country planned by various institutions for the period 1980–1985, each using different means.

The first assignment has been carried to conclusion during the IGP, even though some geomagnetic survey work will continue after the IGP, with the aim of studying particular anomalies in more detail and of following secular variation. The survey was carried out with the help of a new vector magnetometer[1], specifically designed and built for that task, which greatly facilitated and speeded up the work. About 450 sites have been surveyed in four seasons (1974–1977), in and around Switzerland, to insure a good overlap with the country's neighbours. Detailed maps of the elements D, I, F, H, and Z have been produced, as well as of the anomalies of D, I, and F[2]. As an example, Fig. 1 reproduces our map of amplitude anomalies $\triangle$F. Concurrently with the survey a new geomagnetic reference station has been established near Neuchâtel, to replace the Regensberg Observatory which ceased all operations in 1975. A detailed English description of the survey[3] as well as a shorter French version[4] can be obtained from the authors of this report.

The second assignment of initiating a programme of geoelectric soundings has also been completed, at least as concerns the setting up of the equipment, and preliminary soundings have been carried out since the autumn of 1977. Our instrumentation covers the spectral range from periods of a millisecond to 3000 seconds in two separate bands. Data handling in the field is entirely digital and microprocessor-controlled[5]. Part of the data is processed on-line in the field to

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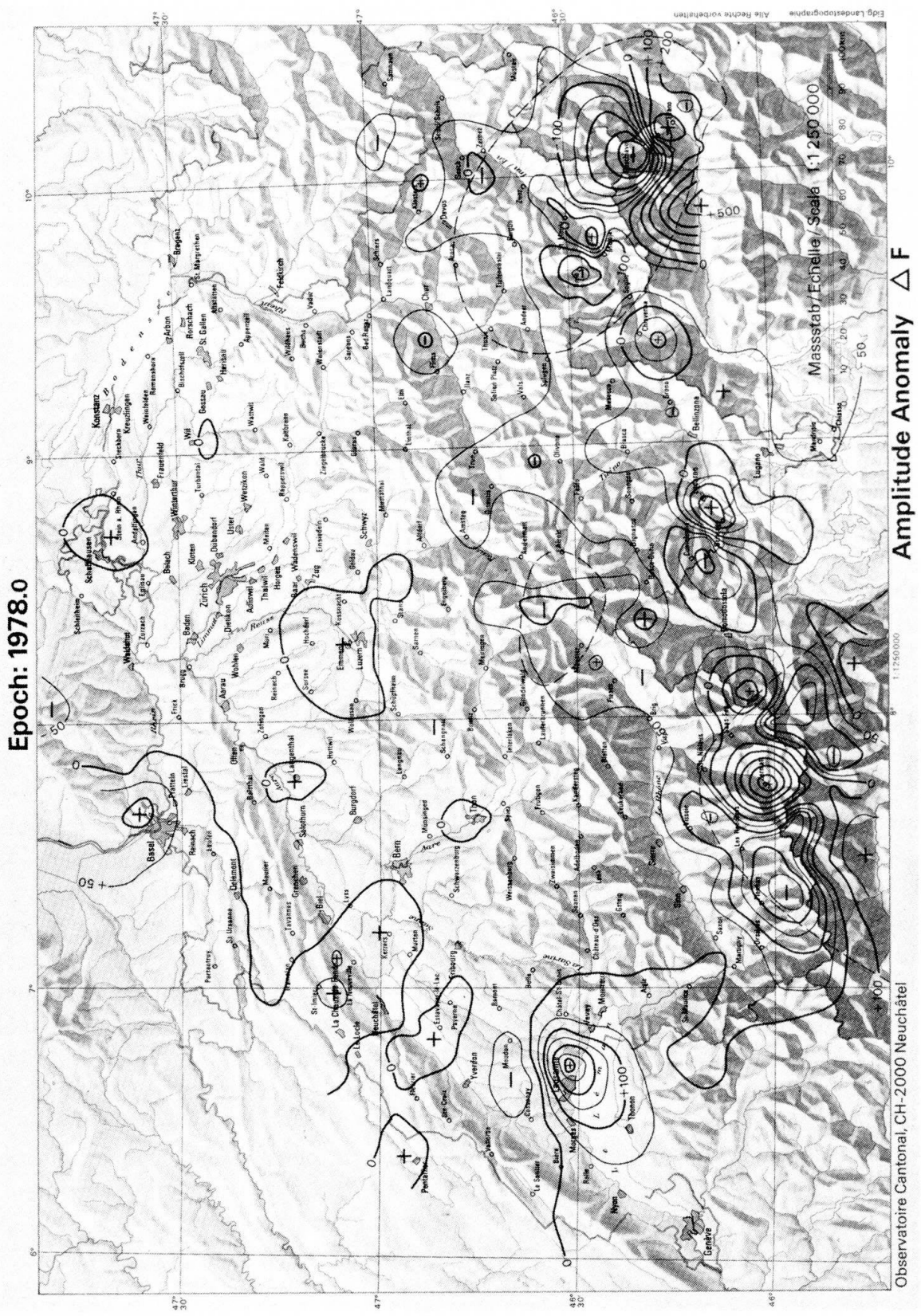

Fig. 1 Map of amplitude or total intensity anomalies, $\triangle F = F - F_{normal}$. The normal field, expressed in nT or gammas, satisfies the simple equation $F_{normal} = 46\,732.5 + 2.8(x-200) + 0.3(y-600)$, where x and y are the Swiss military kilometric coordinates. In this map we note that excepting the Jorat anomaly around Lausanne, all the strong anomalies are on the southern reaches of the Alps. This suggests that the Jorat anomaly is not connected with the formation of the Alps and probably predates that event.

yield provisional apparent resistivity curves as the sounding proceeds. This allows the sounding crew to decide whether a sounding has been successful and to take decisions regarding the pursuit of the survey. The digital data handling has made it possible to use digital filtering and windowing, which were found almost indispensible to overcome the very strong perturbations caused in Switzerland by the electric railways (16⅔ Hz and odd harmonics) and the mains (50 Hz and odd harmonics).

The experimental sounding work was conducted in parallel with some theoretical studies. One project was aimed at clarifying the properties of symmetry of the surface impedance tensor in the case of structures with a vertical plane of reflection symmetry[6]. Another project involved the study of an ocean coast model under E-polarization induction [7-9]. The model investigated consists of a uniform substratum partly shielded by a perfectly conducting, infinitely thin half-plane, the edge of which represents an abrupt ocean coast. This induction problem was for the most part solved analytically; only the last step, the resolution of an integral equation, was carried out numerically. The results obtained are in good accord with the well-known geomagnetic ocean coast effects.

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