As per table 1 magnetic methods are less dominant than seismic, gravity, electric or electromagnetic methods in hydrogeophysics but excel for mapping structures controlling groundwater flow at regional scale .

Their principle is to detect variations in Earth's Magnetic field caused by **contrasts in magnetic susceptibility** in another term it is the measure the **remnant magnetic** field associated with a rock. As known The earth's field is superimposed by small-scale magnetic anomalies related with magnetized rocks (Figure 14) which will Define the rock type.

the susceptibility of rocks in an ascending order may be addressed as follows:

(k ~ 0.0001) sedimentary rocks –

metamorphic rocks (0.001)

acid volcanic and plutonic rocks basic volcanic rocks (0.1).
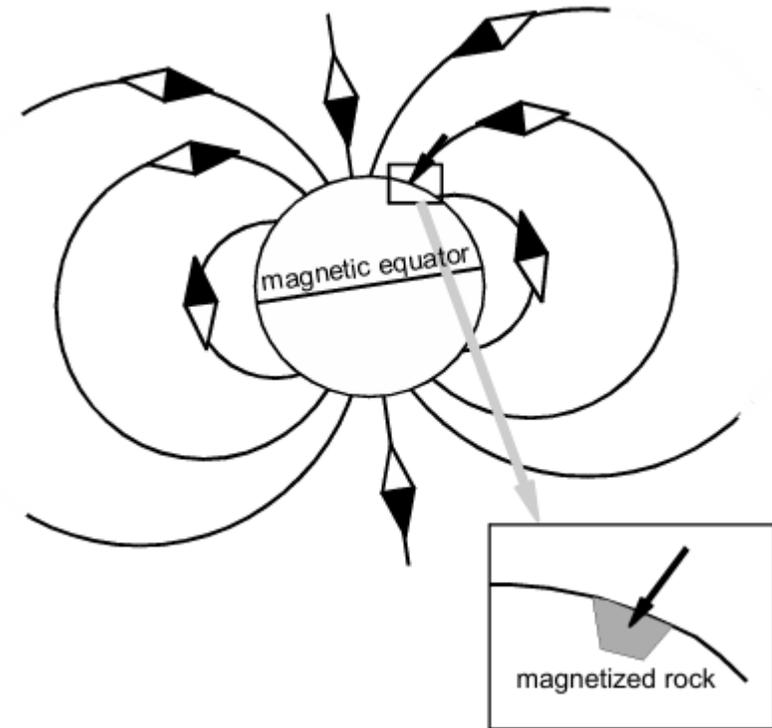
Fig 14 : The earth magnetic field and the magnetization of rocks (Source: Ground water geophysics R.Kirsch 2ed 2009)

Ground magnetic survey: It is the **simplest, most cost-effective, and rapid** method for mapping near-surface geology and structural features. It is a passive surveys measuring total magnetic field intensity **nT** (nano Tesla) variations using portable magnetometers to detect susceptibility contrasts from lithology, faults, or intrusions influencing aquifer geometry.

How it works?

A walker carries a portable magnetometer along a grid (1–5 m spacing) and records anomalies from induced/remanent magnetization which will be processed to remove regional field and create a map of magnetic anomalies.

Example: In a hard rock area where groundwater is confined to fractures, a ground magnetic survey can identify linear, low-magnetic anomalies that indicate fault zones where magnetite has been weathered away. Drilling targets are placed directly on these linear lows (creux linéaires) to intersect the water-bearing fault.

Chap IV: Magnetic methods used in Hydrogeology

Ground magnetic method (survey): It is the **simplest, most cost-effective, and rapid** method for mapping near-surface geology and structural features. It is a passive surveys measuring total magnetic field intensity **nT** (nano Tesla) variations using portable magnetometers to detect susceptibility contrasts from lithology, faults, or intrusions influencing aquifer geometry.

How it works?

A walker carries a portable magnetometer along a grid (1–5 m spacing, may change) and records anomalies from induced/remanent magnetization which will be processed to remove regional field and create a map of magnetic anomalies.

Example: In a hard rock area where groundwater is confined to fractures, a ground magnetic survey can identify linear, low-magnetic anomalies that indicate fault zones where magnetite has been weathered away. Drilling targets are placed directly on these linear lows (creux linéaires) to intersect the water-bearing fault.

ANRH (Algeria) Hoggar surveys (2022) mapped basalt fractures → 15 m overburden, guiding 10 new wells.

Chap IV: Magnetic methods used in Hydrogeology

Airborn magnetic (method) survey: It provides **regional-scale coverage** by measuring magnetic field at 50–100 m altitude to map large-scale structures (basins) and controlling regional groundwater recharge.

How it works?

This time the magnetometer is on helicopter or fixed wings plane, the grid spacing is greater (50-200 m) and the covered area can reach easily 1000 Km2 it gives a regional anomalies map able to define the depth and structure of sedimentary basins, mapping large-scale fault systems.

Example: A government agency flies an airborne magnetic survey over volcanic-alluvial aquifers and conducted 228 profiles (NE-SW/NW-SE), 100 m line spacing.

It gave High anomalies: Basalt flows (magmatic highs) and Lows: Fractured/weathered zones (10–50 m depth). Interpreted as NE-SW lineament of recharge that contain an aquifer of 20–40 m thickness.

Important: There are other magnetic methods but they are not cost effective and not easy to implement.