Paleo-magnetism

How the rocks can tell us at which latitude they formed.
The diagram on the left shows our earth and its magnetic field. The curved lines are the magnetic field lines. A compass will align itself with the magnetic field lines. The arrow head on the lines shows the direction in which the north end of the compass will point.
Inclination or dip of a compass needle

- Now look at the diagram showing earth’s magnetic field lines. Near the poles the field lines are nearly vertical, whereas near earth’s equator the field lines are parallel to the earth’s surface (i.e., the field lines are horizontal).
- The picture on the right shows the direction of field lines at mid-latitudes in the northern hemisphere (point ‘n’ on the diagram in the left), at equator (e) and at mid-latitude in southern hemisphere (s). If you take compass at point ‘n’ the compass will be inclined with the north end of the compass pointing towards ground. If you take a compass to south pole, the compass will be almost vertical with the south end of the compass pointing towards the ground.
Magnetic minerals are like compass

• Very simply stated: magnetic minerals in a magma and in sediments falling through water (like in an ocean) are free to move and rotate because they are surrounded by liquid (magma or water).

• These tiny minerals behave as a tiny magnet and like a magnet they have a north and south pole. Just like a regular magnet, the north pole of the magnetic minerals point towards the north magnetic pole and the south pole point towards the south magnetic pole.

• Like all magnets, the minerals align themselves with the earth’s magnetic field lines at the place where the rock containing the minerals are forming.
Remanent Magnetism

• Since the magnetic minerals align themselves with the earth’s magnetic field lines – magnetic minerals surrounded by liquid magma or by water will be nearly horizontal near the equator but will progressively become steeper as we move from the poles to the equator.

• Once the magma solidifies or once the magnetic minerals get deposited in the ocean bottom sediments, the magnetic minerals are fixed in place and thus contains the information of the magnetic field of the place where the rock had formed. This info is what we call TRM (Thermal Remanent Magnetism) in Igneous Rocks or DRM (Depositional Remanent Magnetism) in sedimentary rocks.

• In the northern hemisphere the north end of the magnetic field of these minerals will point towards the ground (top right) and in the southern hemisphere the north end of the magnetic field of these minerals will point up.
The above is a cross section showing three geological layers and the direction of magnetic field preserved in those layers. Where did layer A form? A) at the south pole B) at equator C) at north pole or D) at mid-latitude in northern hemisphere. Try to decide where in the earth the direction of magnetic field is inclined and the north end of a magnet point towards ground. Now find out the paleo-latitude of the layers B and C. Can I say that this continent was in southern hemisphere 40 million years ago (40 Ma) then moved to equator around 20 Ma and is in the mid-latitude of northern hemisphere now?