

Core-log integration

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Well Logging Principles and Applications
G9947 - Seminar in Marine Geophysics
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Core-log integration issues

1. Measurement resolution
2. Depth matching
3. In situ versus laboratory conditions

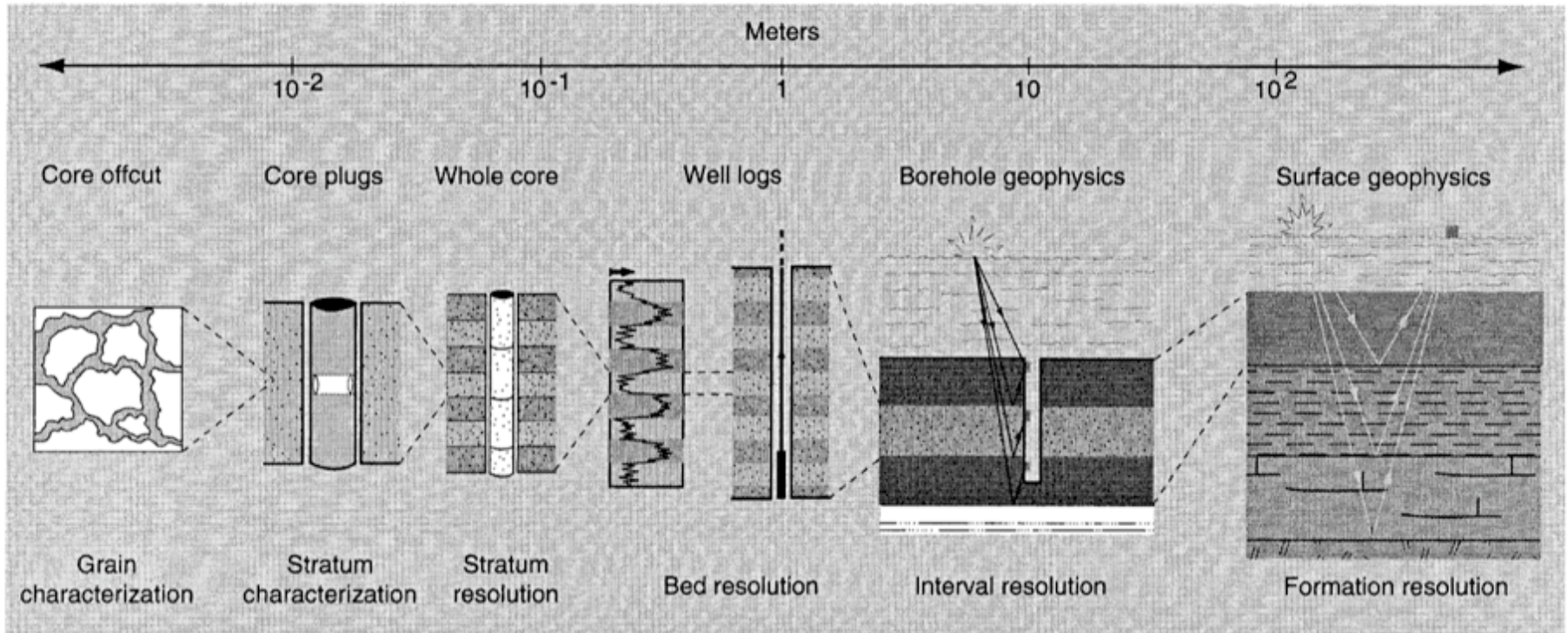


Figure 1. Schematic diagram illustrating the different scales of measurement in geophysics [after *Worthington et al.*, 1991]. The span of measurements from core samples to seismic surveying is greater than 10^4 , complicating the interpretation of data from samples to regional geology without intermediate-scale logging and borehole measurements.

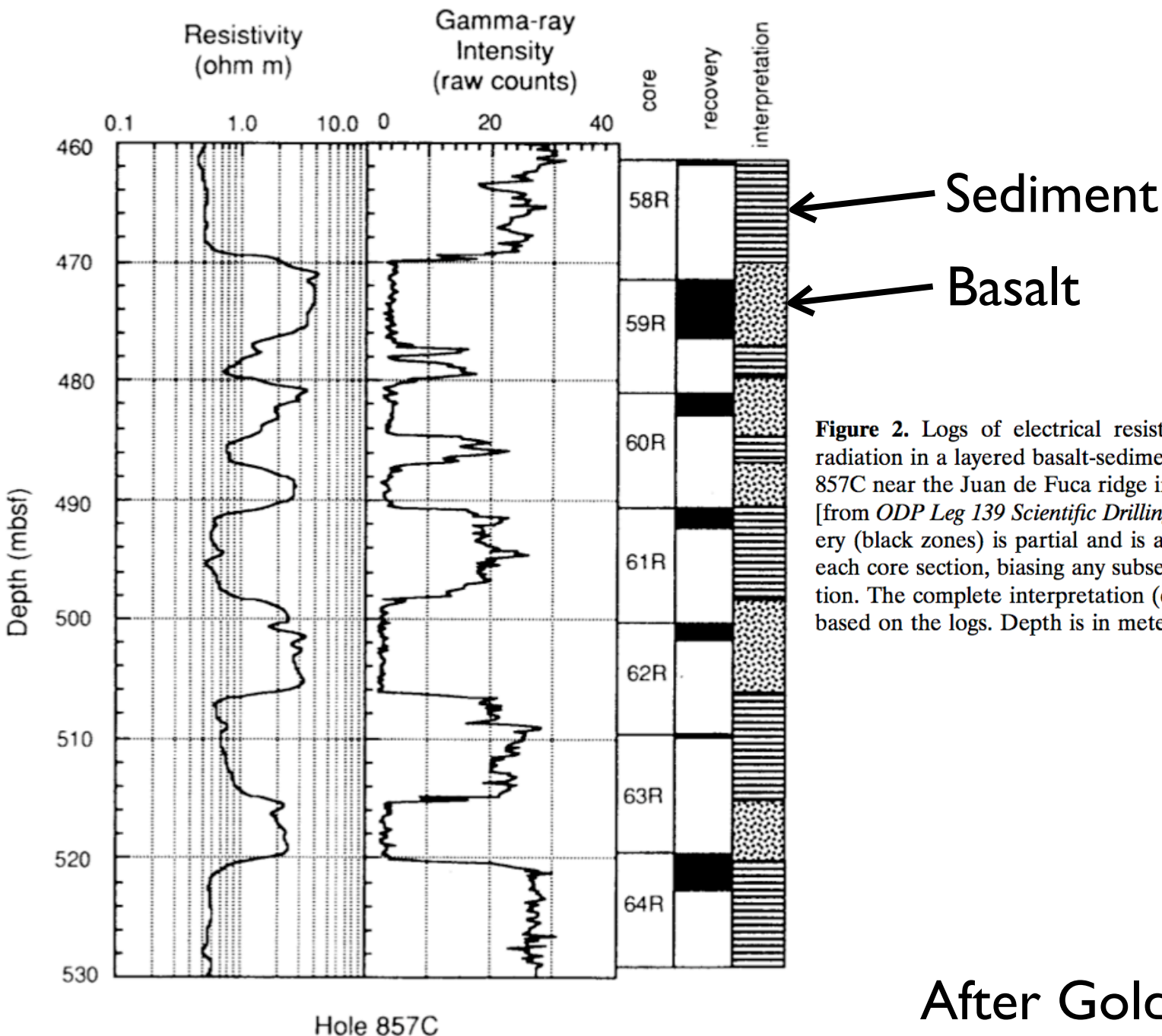
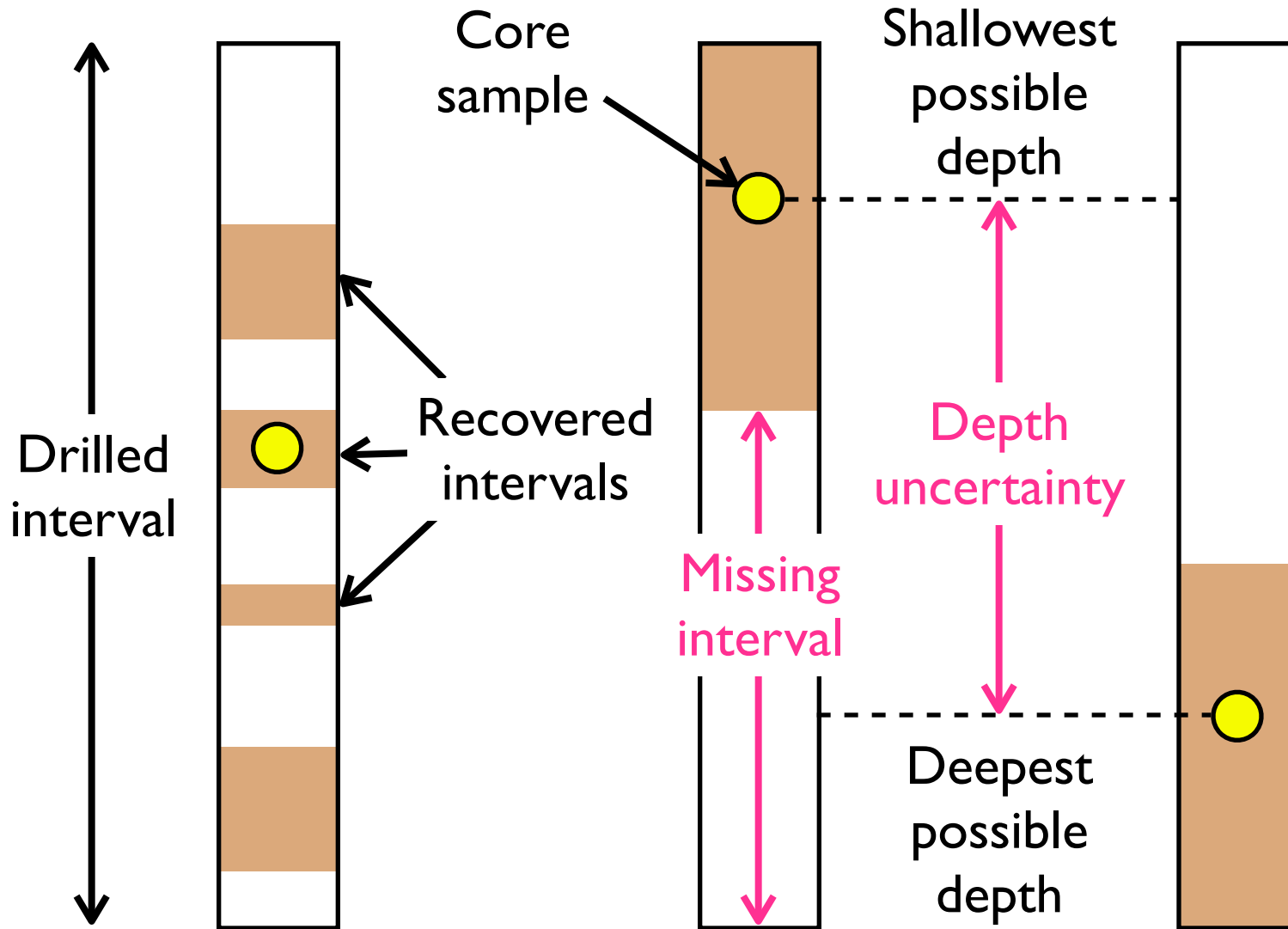
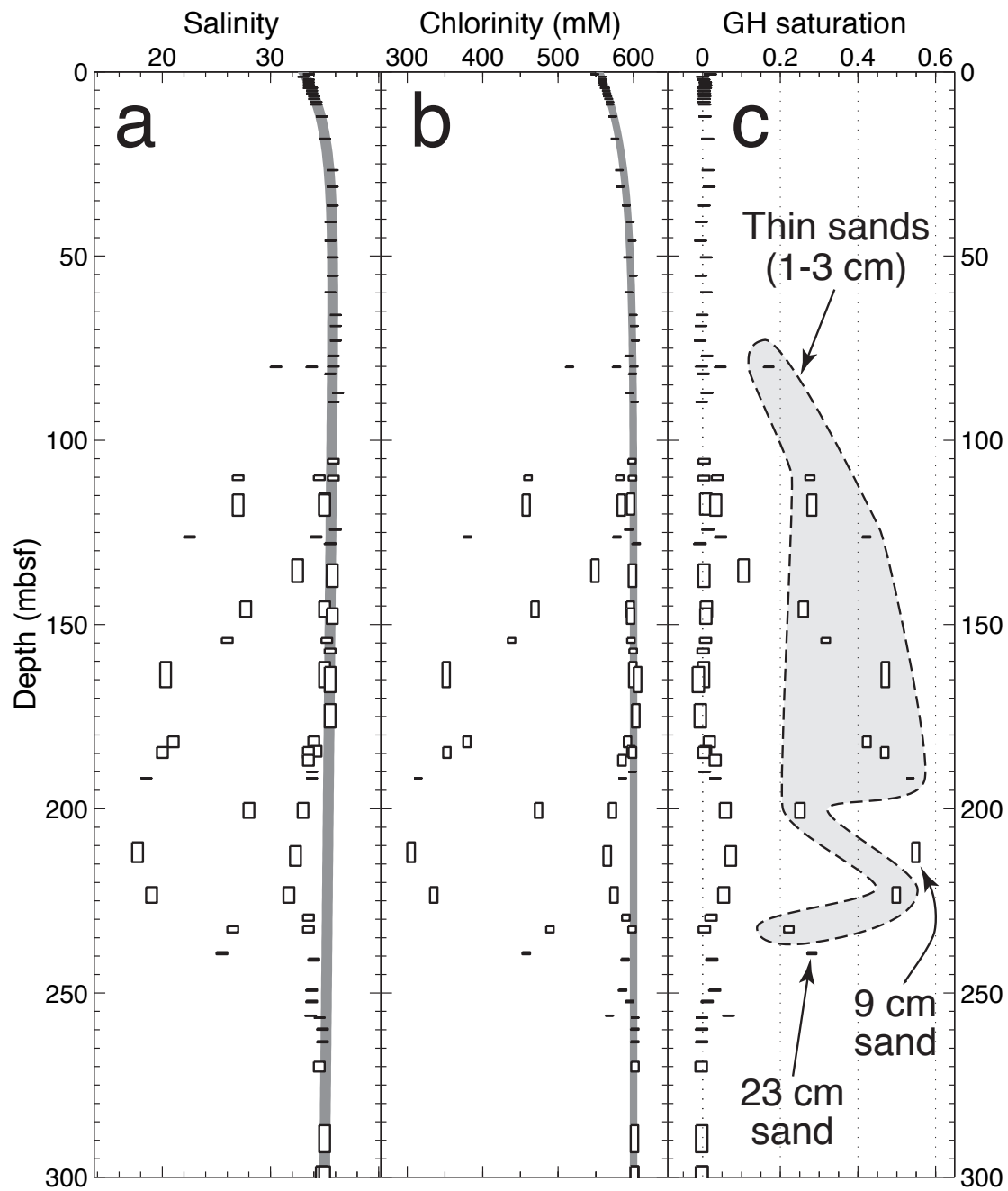


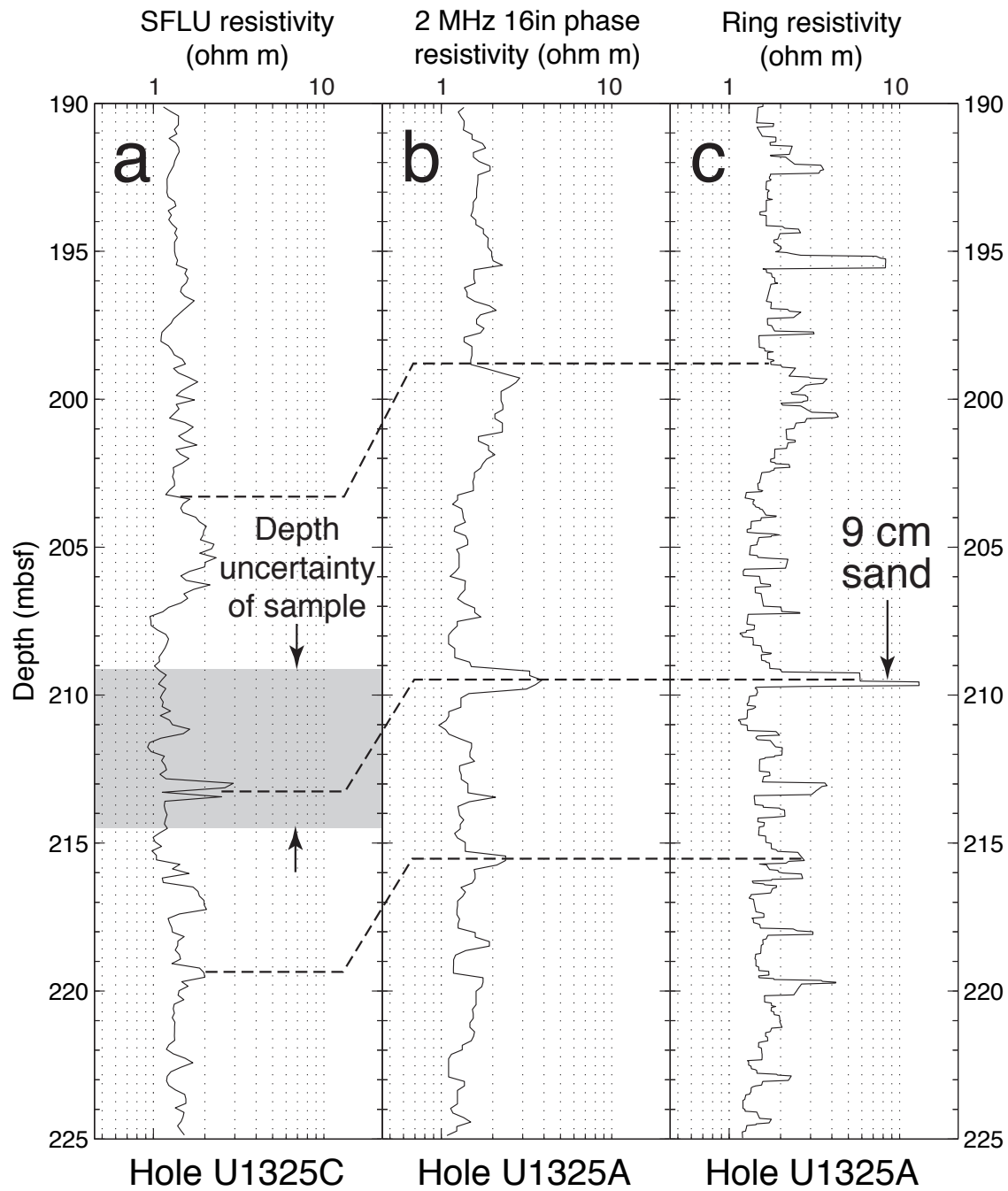
Figure 2. Logs of electrical resistivity and natural gamma radiation in a layered basalt-sediment sequence in ODP Hole 857C near the Juan de Fuca ridge in the north eastern Pacific [from *ODP Leg 139 Scientific Drilling Party*, 1992]. Core recovery (black zones) is partial and is arbitrarily set at the top of each core section, biasing any subsequent geologic interpretation. The complete interpretation (dotted zones are basalt) is based on the logs. Depth is in meters below sea floor (bsf).

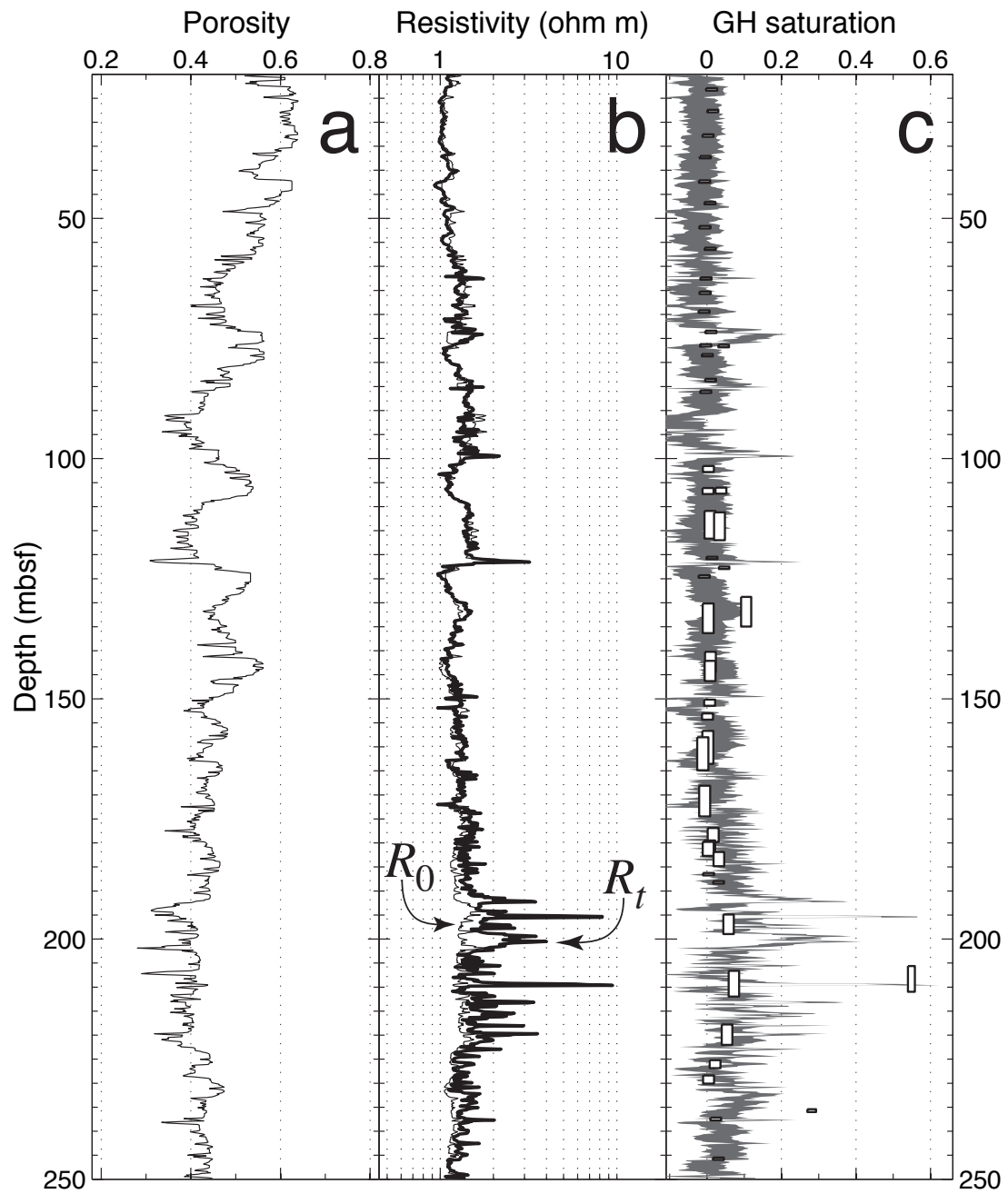
After Goldberg, 1997

Core sample depth









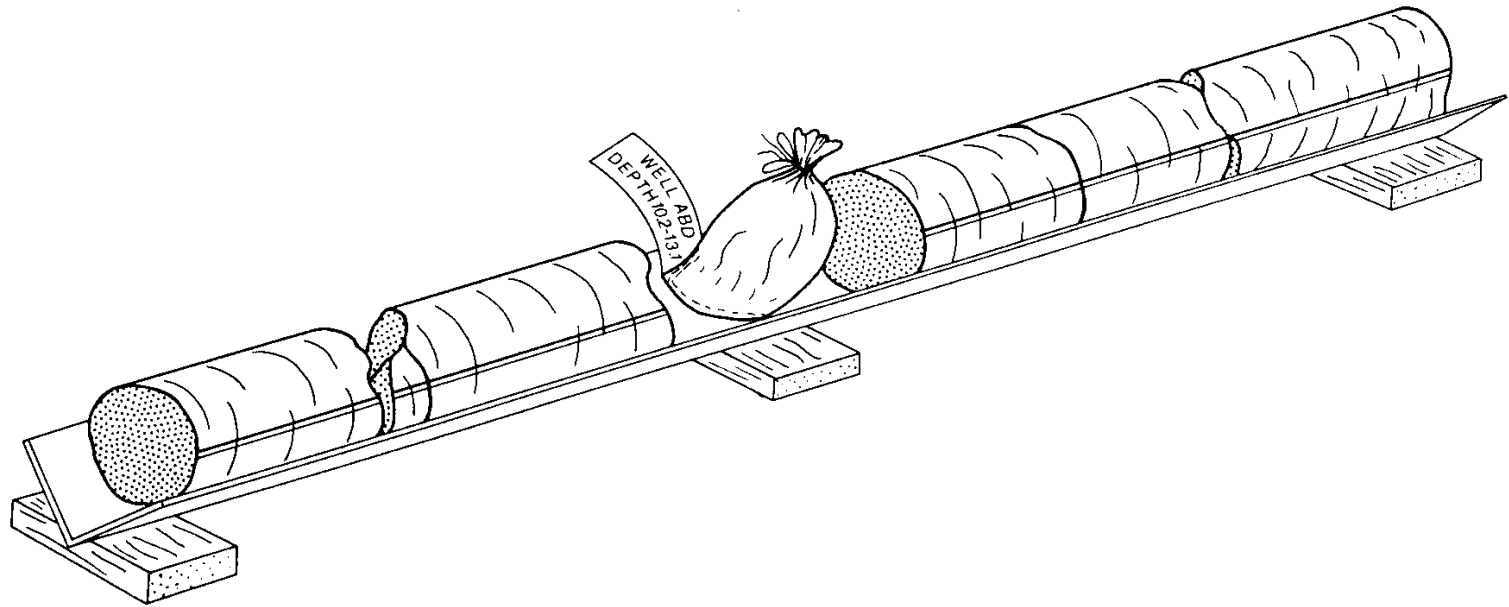


Fig. 3.2 Core pieces fitted together on a length of angle-iron. A rubble section is contained in the bag. The parallel lines marked on the core, which would be in contrasting colours, indicate the way up.

in si·tu

in the natural or original position or place

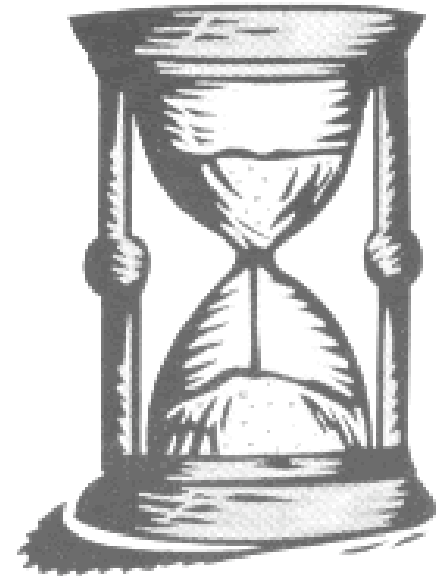
Pronunciation: (")in-'sl-(")tü, -'si-, -(")tyü *also*




-'sE-, -(")chü

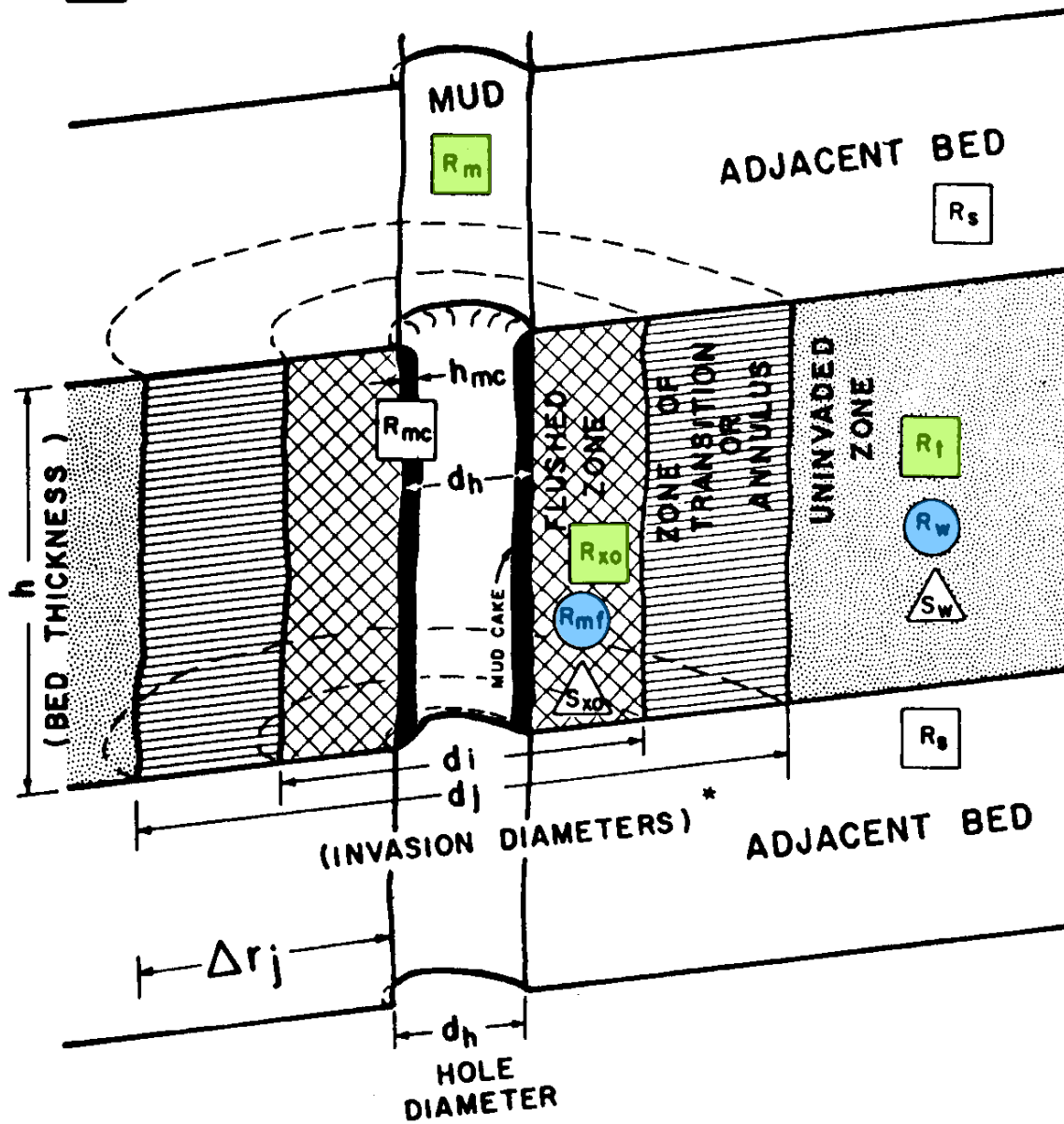
Function: adverb or adjective

Etymology: Latin, in position

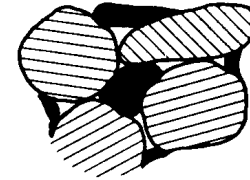
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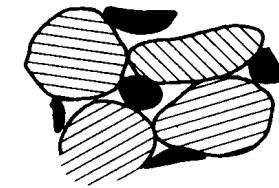
-  Resistivity of the zone
-  Resistivity of the Water in the zone
-  Water Saturation in the zone.



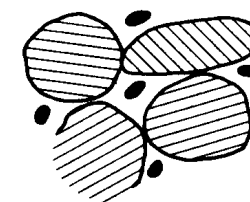
Water wet sand



(a)



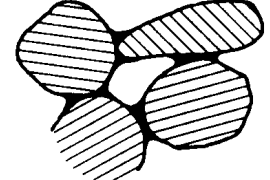
(b)



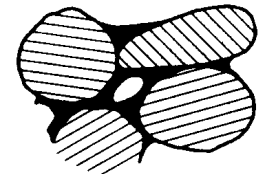
(c)

 Water

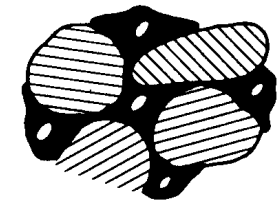
Oil wet sand



(d)

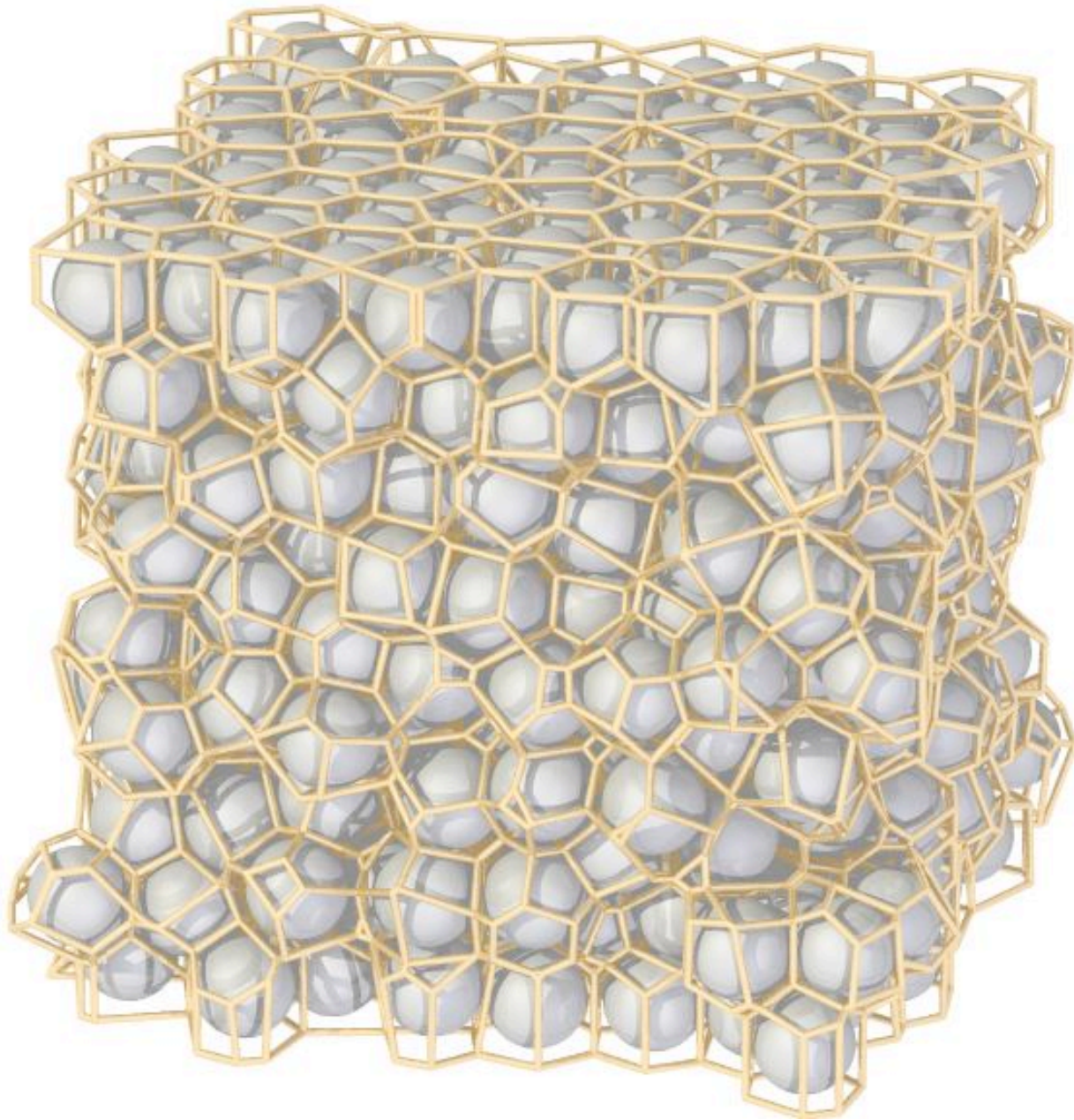


(e)



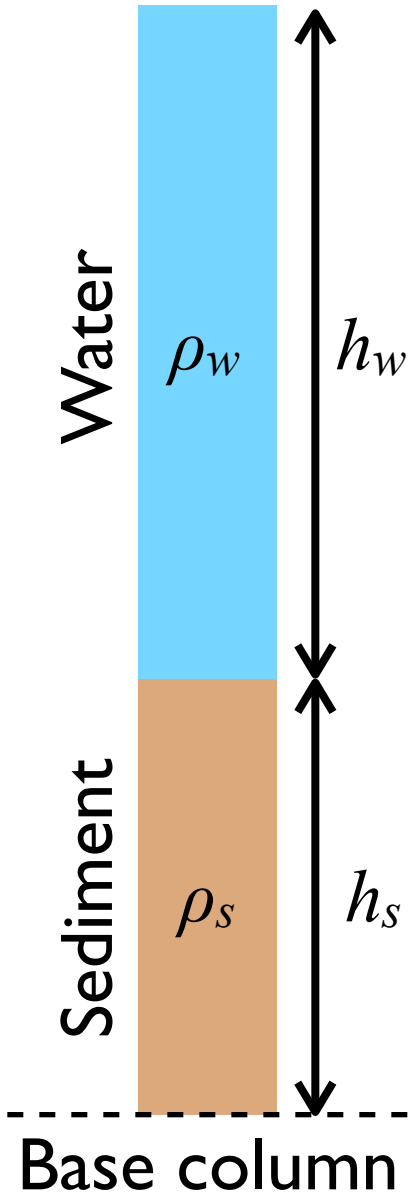
(f)

 Oil



Random close
packing of
spheres:
density ≈ 0.64 ,
porosity ≈ 0.36

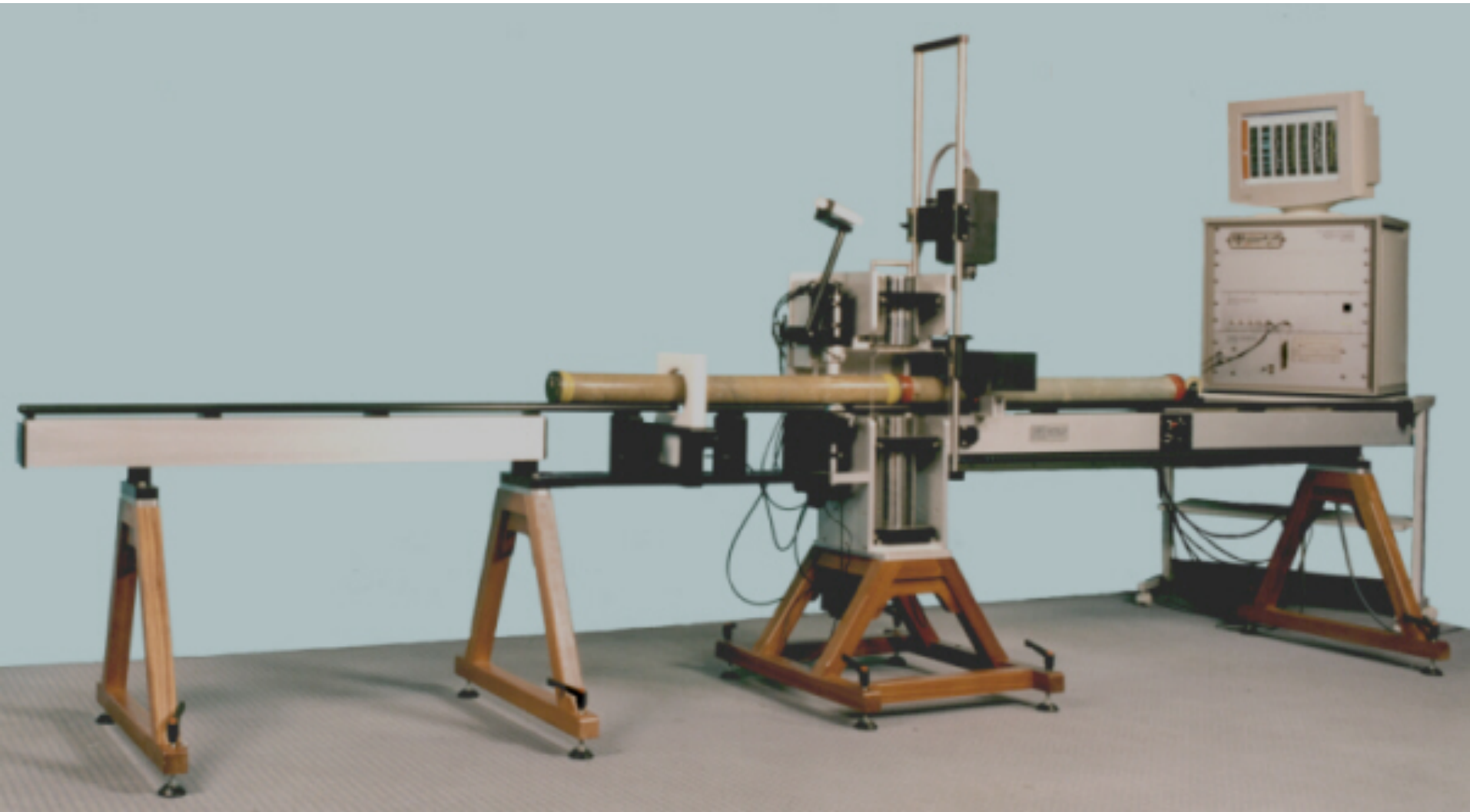
Effective stress



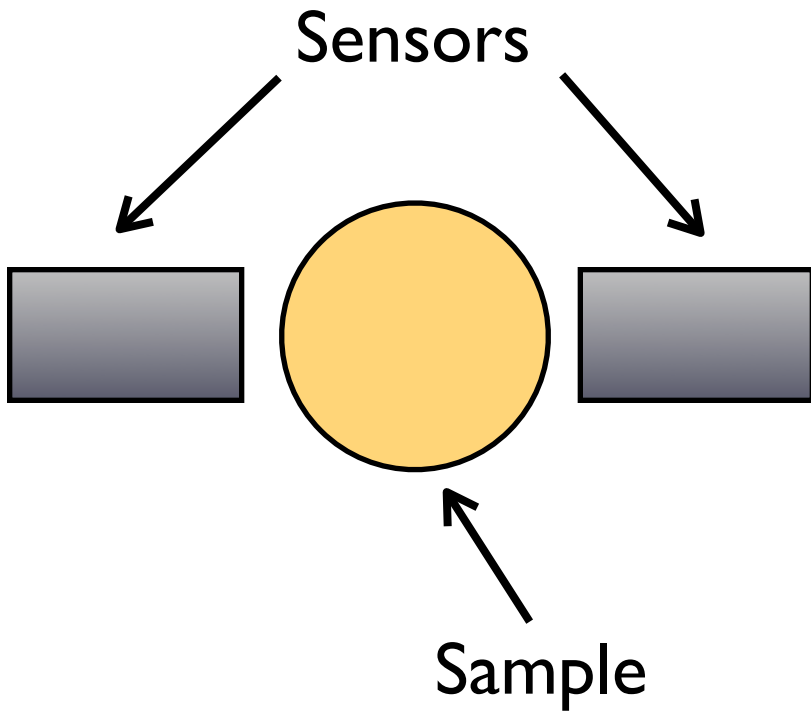
- Stress or pressure: ρgh
- Lithostatic stress at base column: $g(\rho_w h_w + \rho_s h_s)$
- Hydrostatic pore pressure at base column: $g\rho_w(h_w + h_s)$
- Effective stress (Terzaghi, 1936): lithostatic stress – pore pressure

$$\begin{aligned}\sigma_{\text{eff}} &= gh_s(\rho_s - \rho_w) \\ &= gh_s(1 - \phi)(\rho_g - \rho_w)\end{aligned}$$

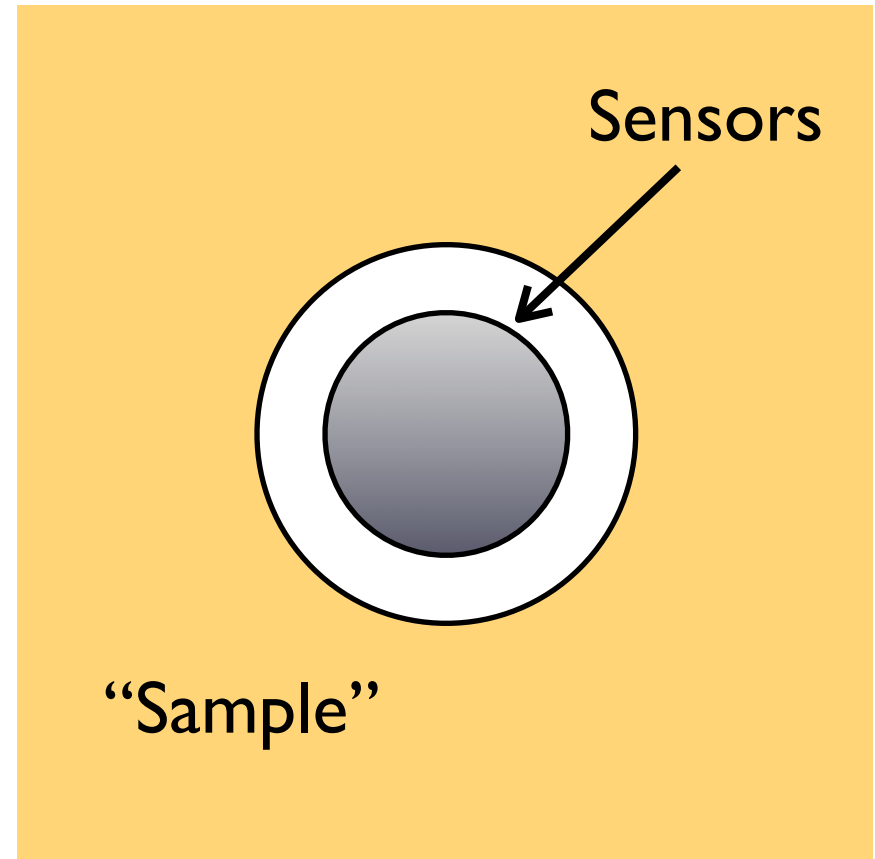
Multisensor track (MST)



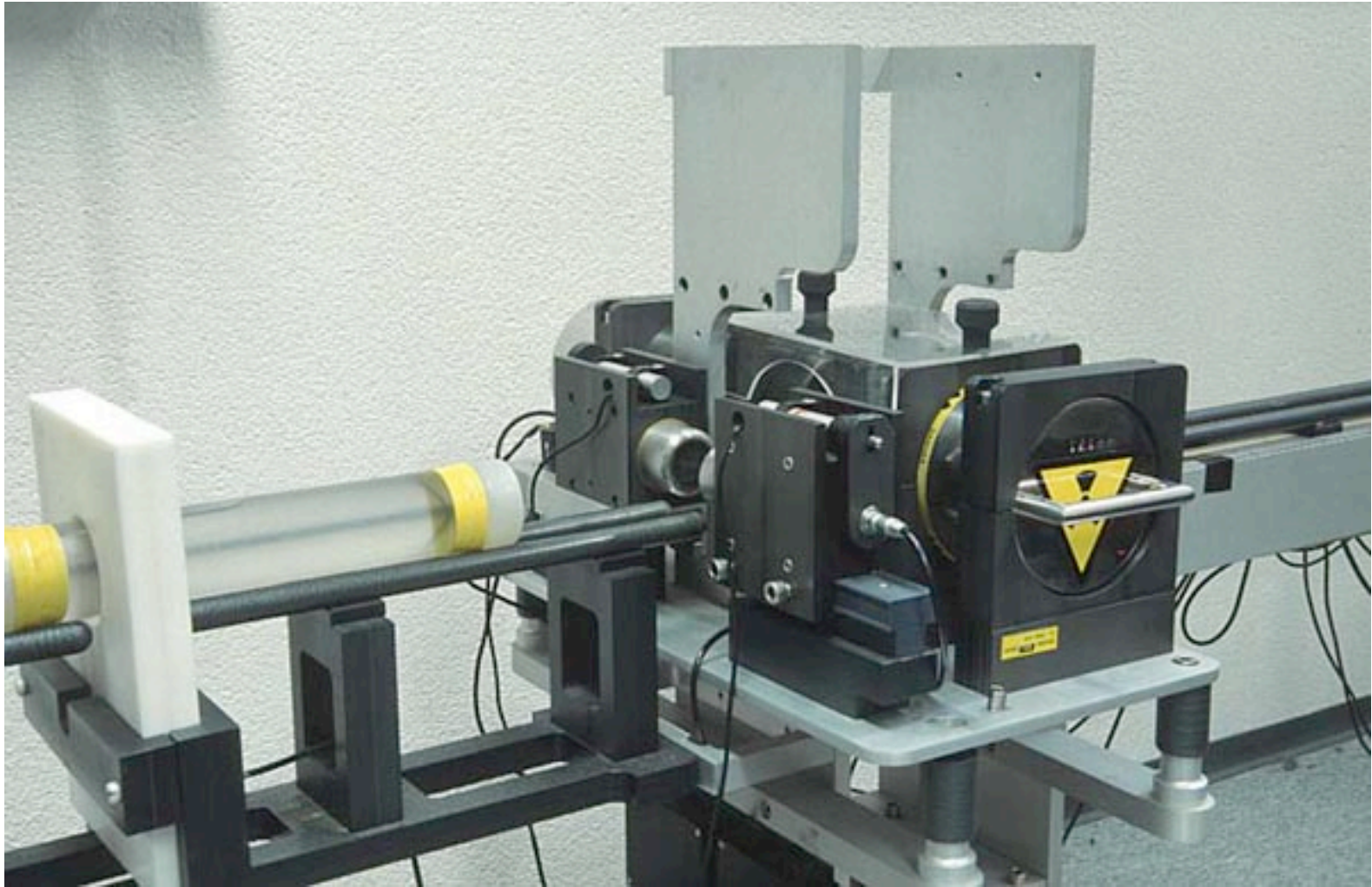
Measurements on core samples



Measurements in the borehole

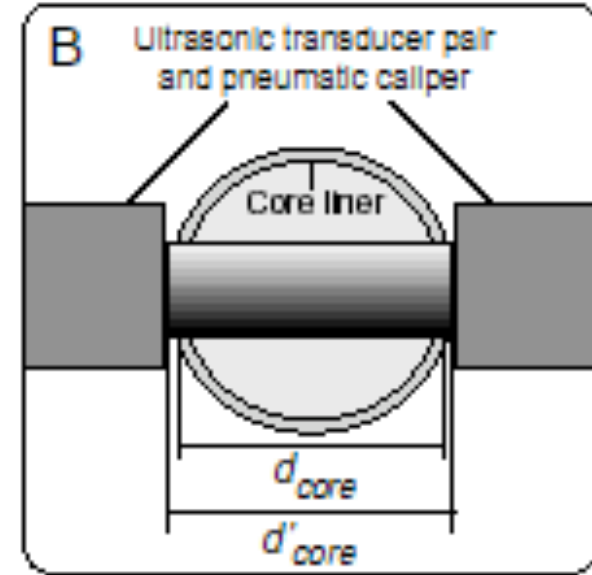
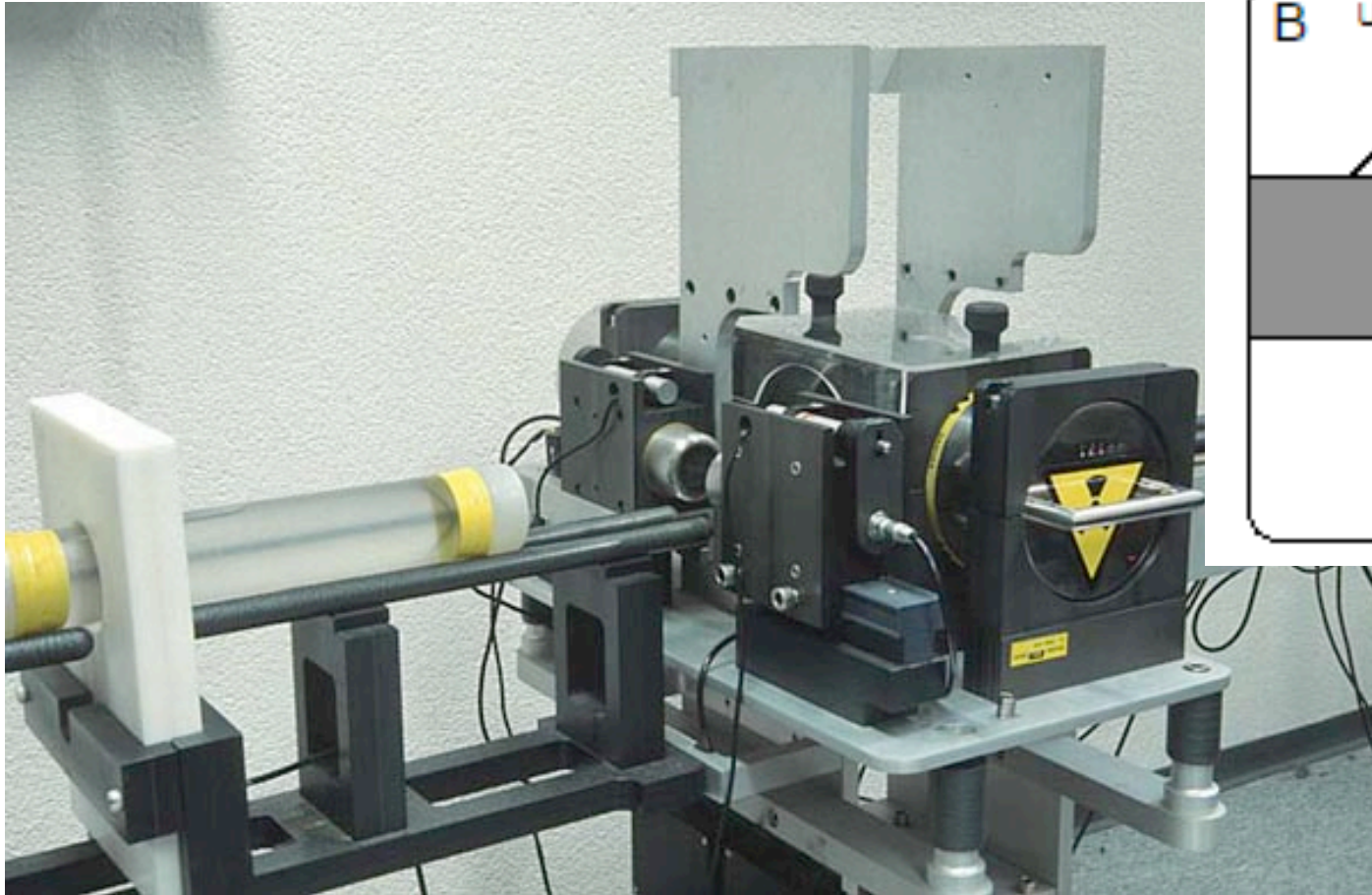


Wet bulk density measurement



^{137}Ce source gamma-ray attenuation porosity evaluator (GRAPE)

P-wave velocity measurement



Transducer-receiver 500 kHz 2 μ sec pulse