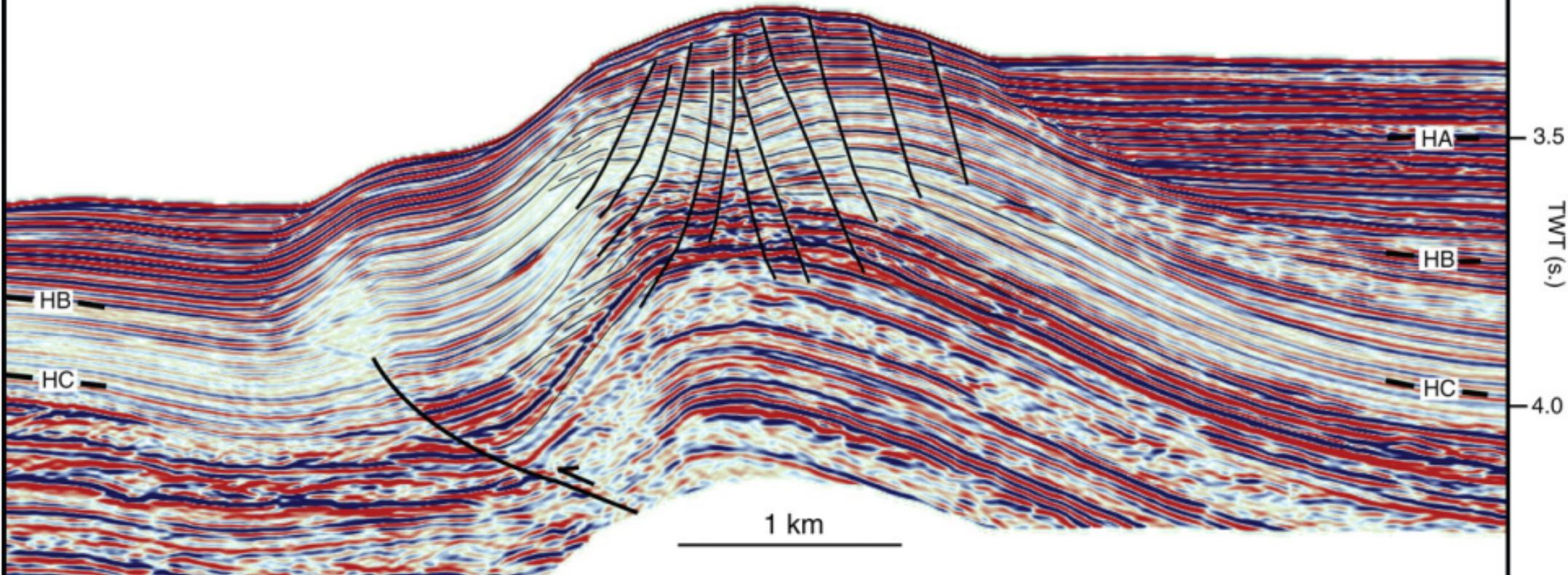
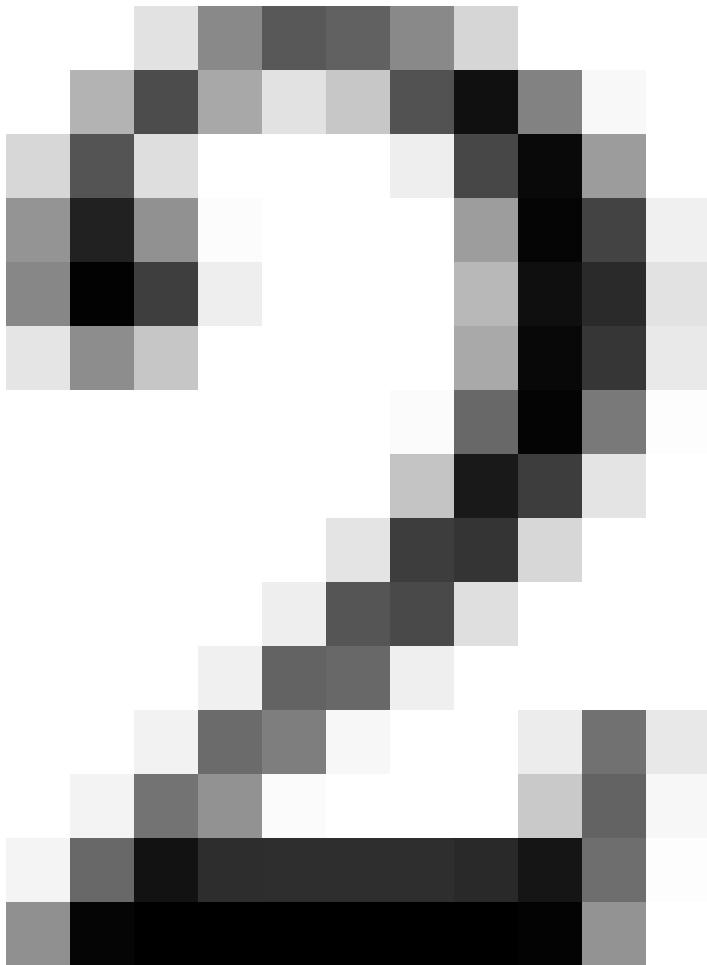


NW

Crestal normal faults

SE



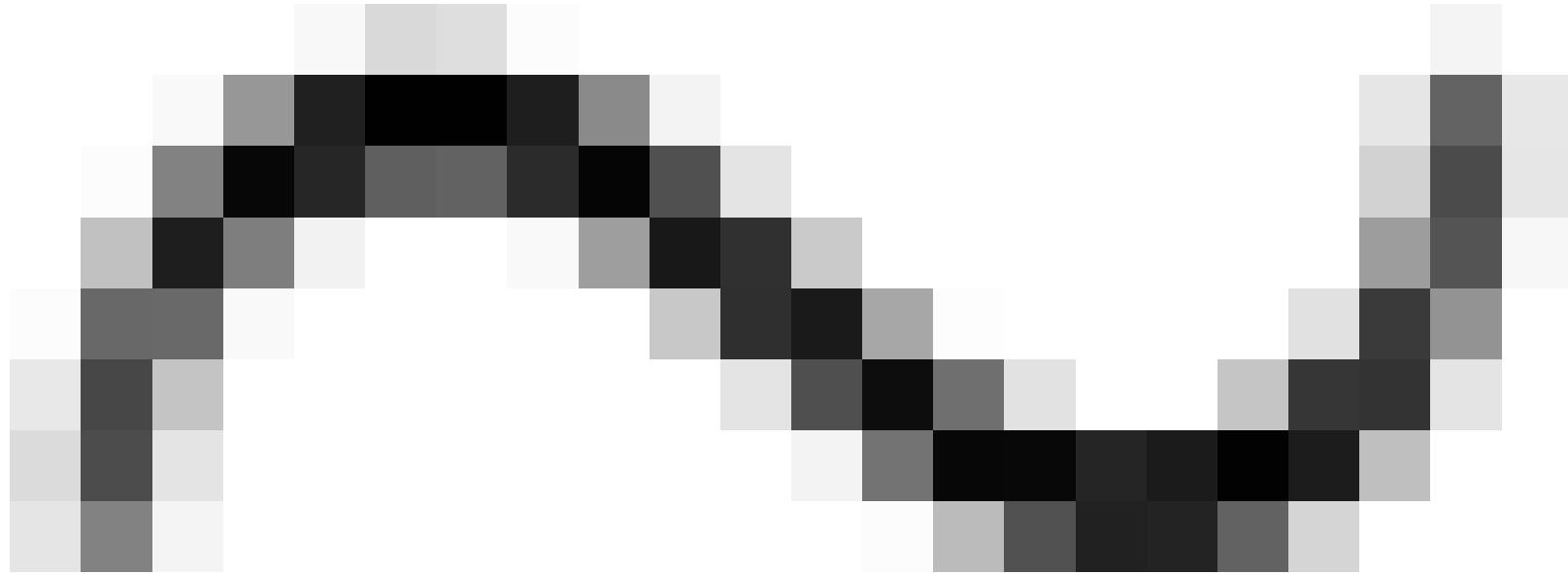


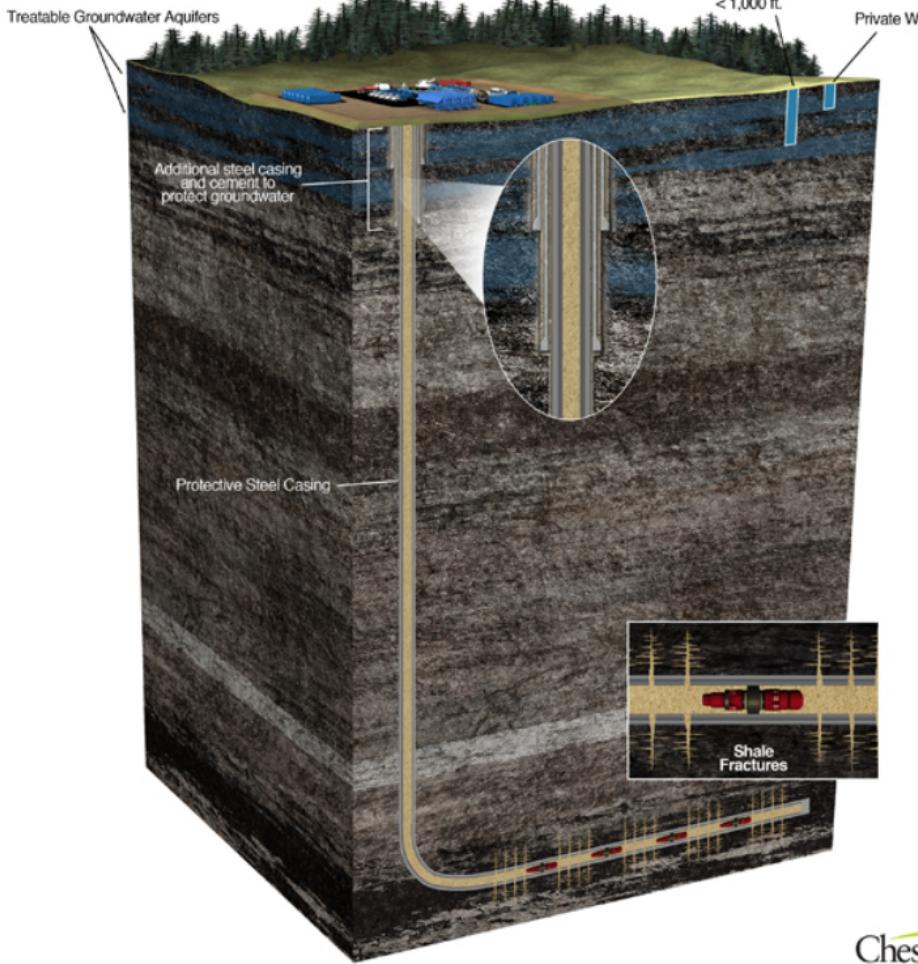
~1850



~2010







Risk-Based
Geomechanical
Screening

Stress Man

MUDLINE SUBSIDENCE



FAULT ACTIVATION

CASING CRUSHING

COMPACTION DRIVE

CASING
SHEAR

SAND PRODUCTION



RESERVOIR YIELD

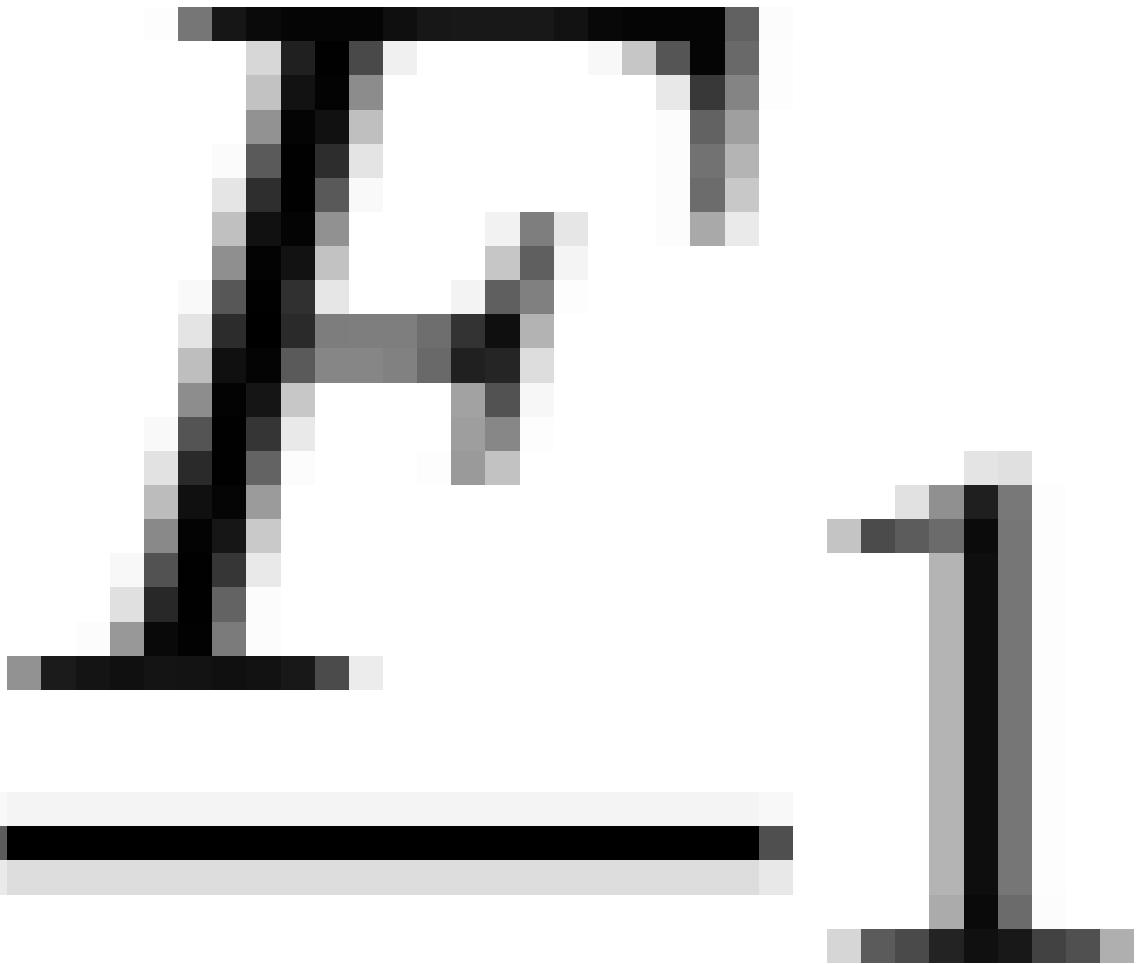
PERMEABILITY LOSS

CASING BUCKLING

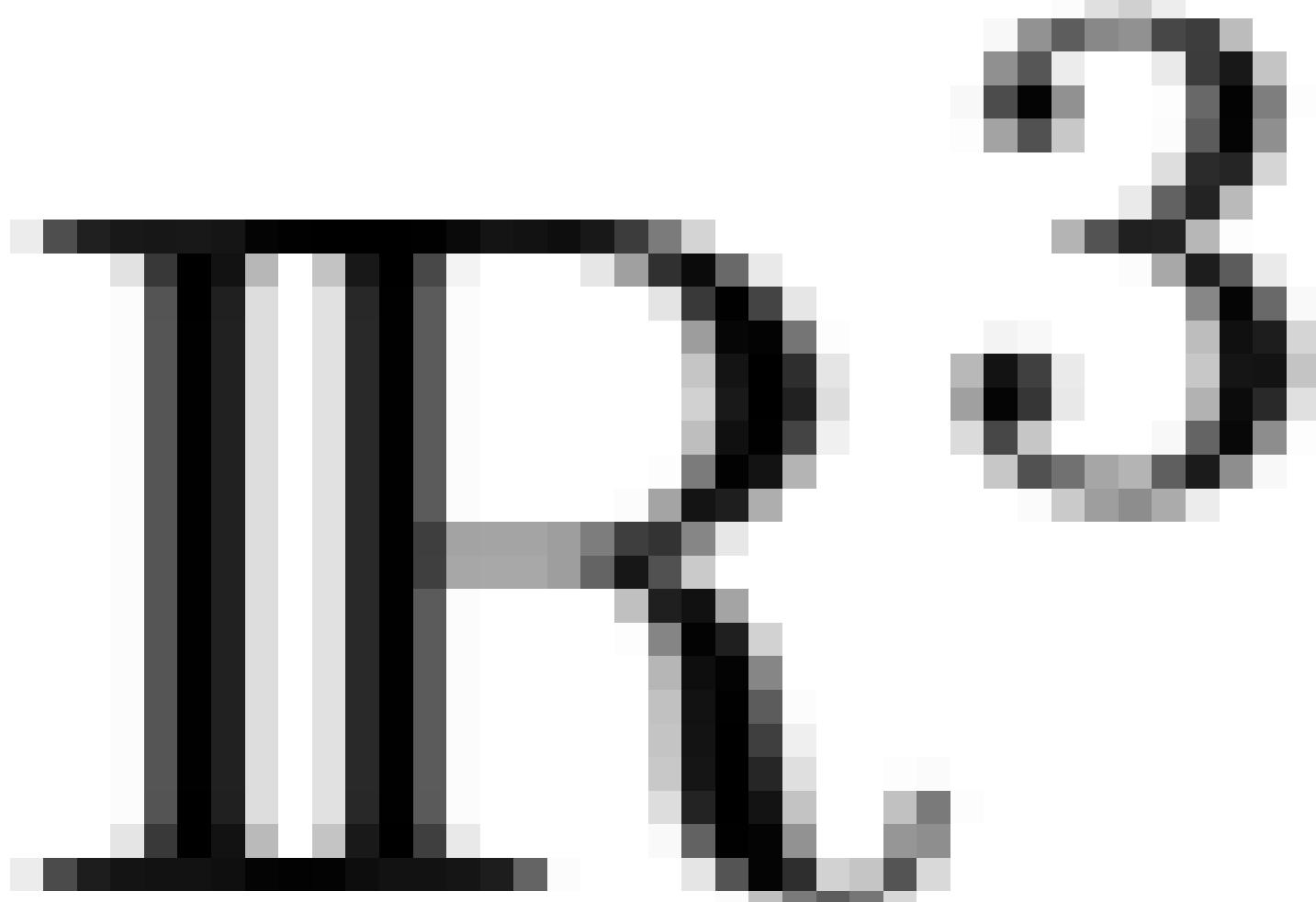
S_V

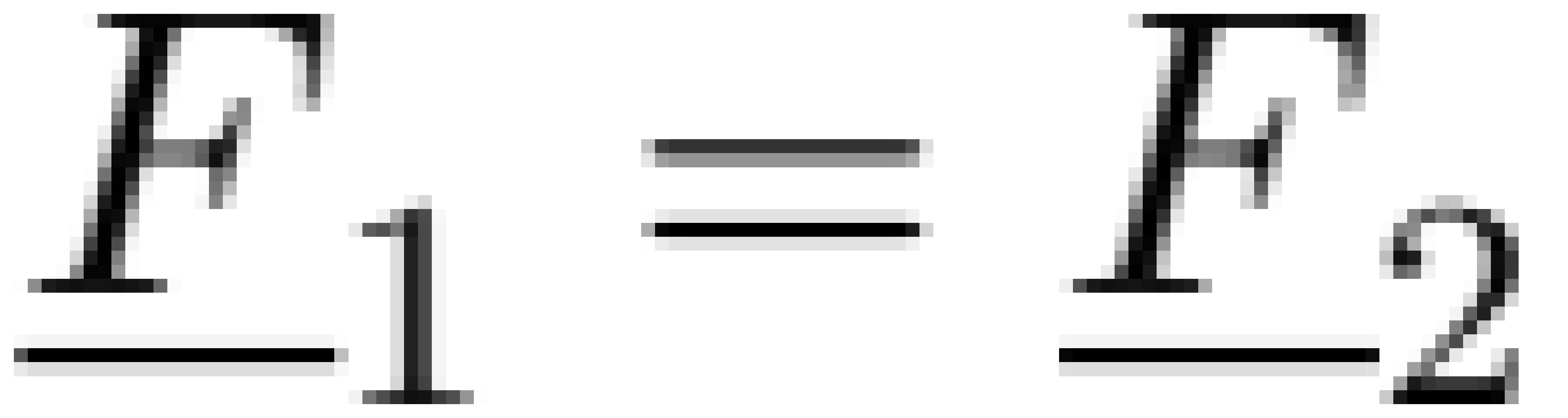




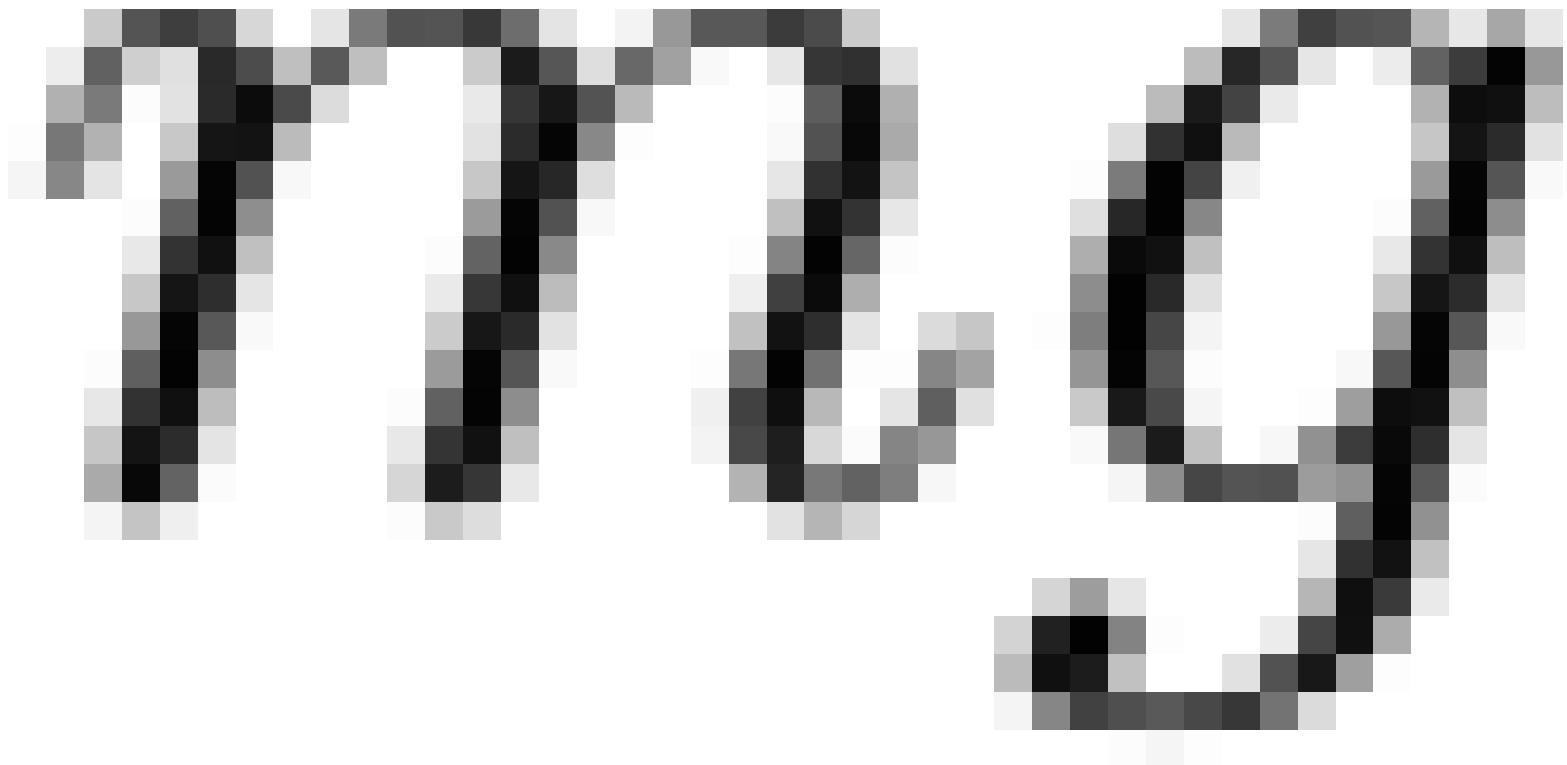


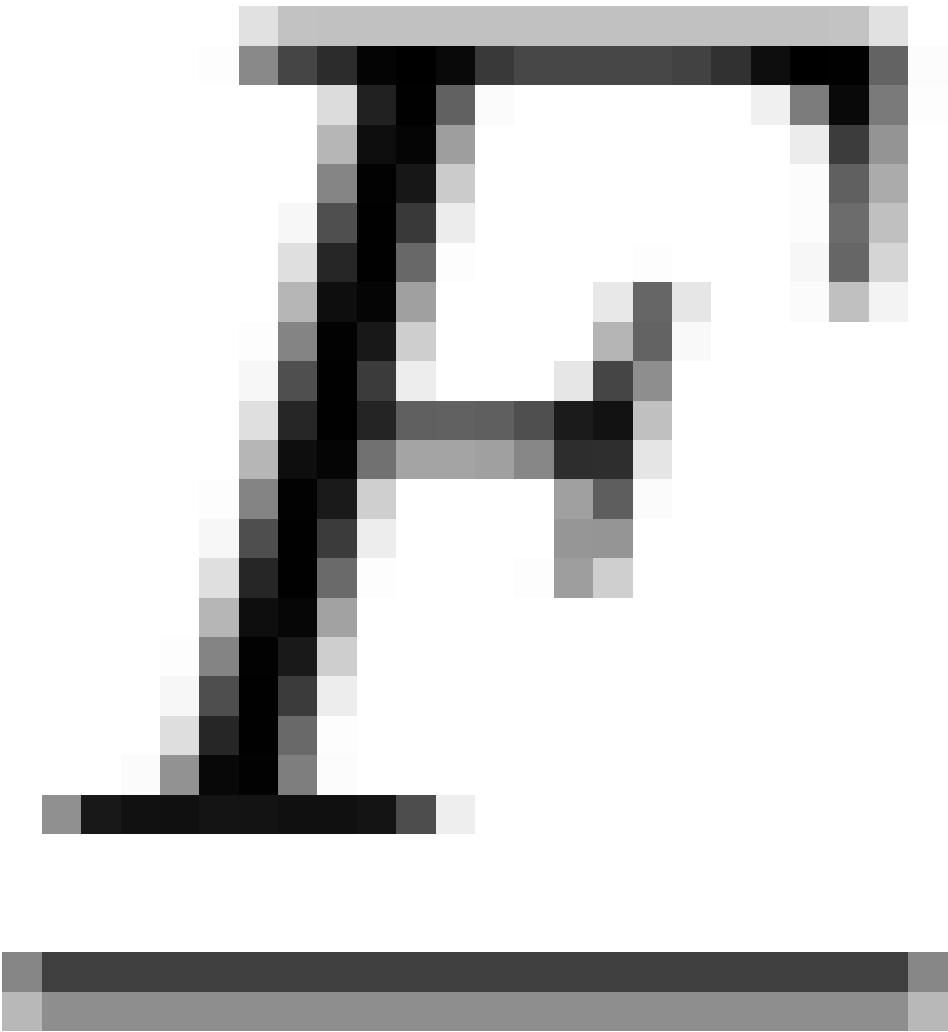


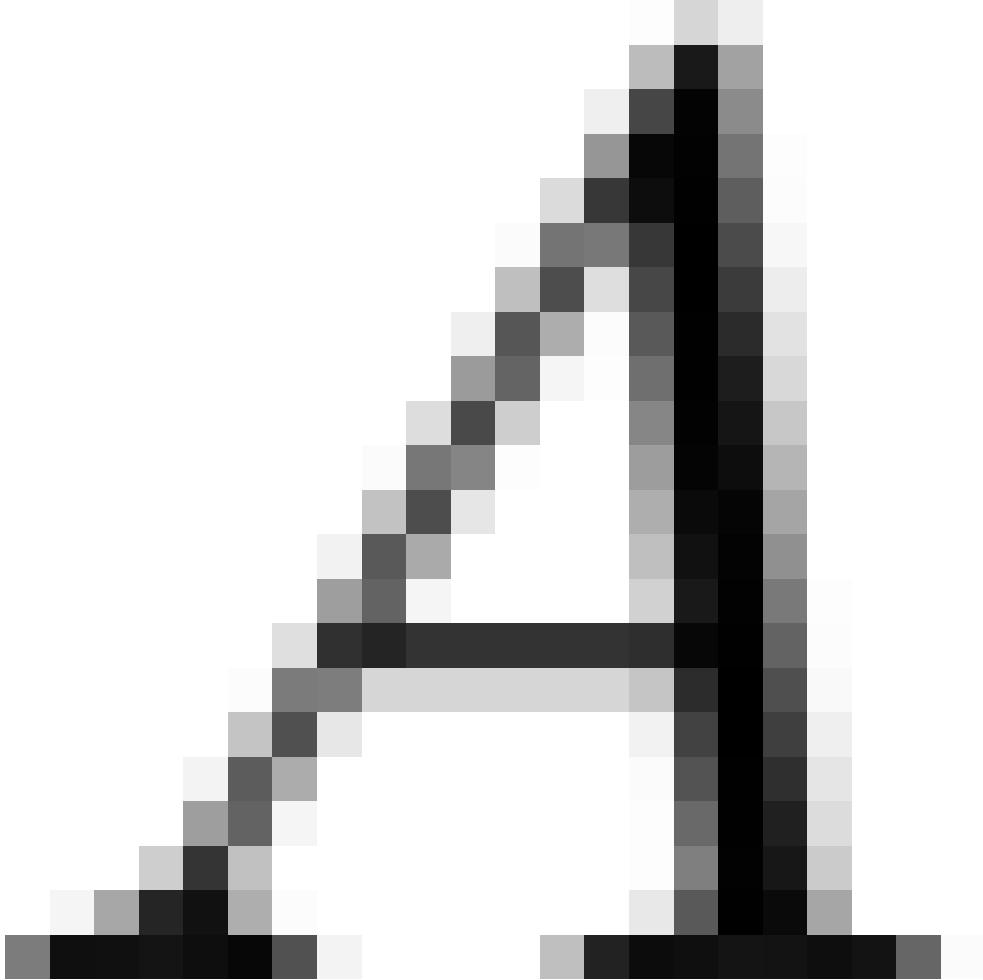












P

S

S

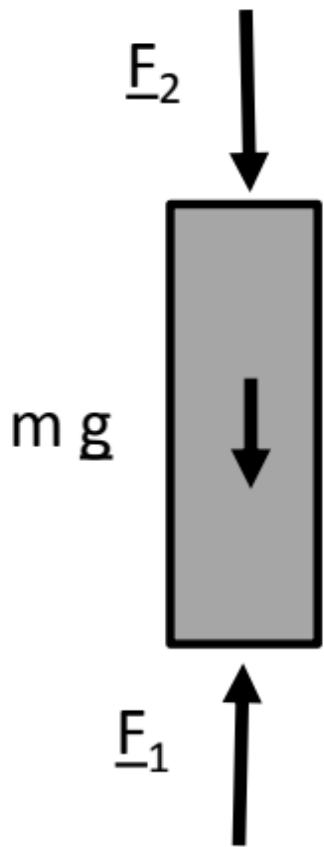
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S

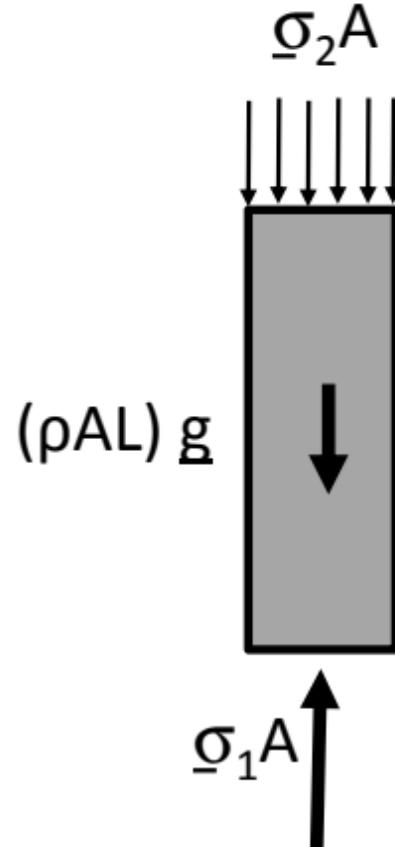
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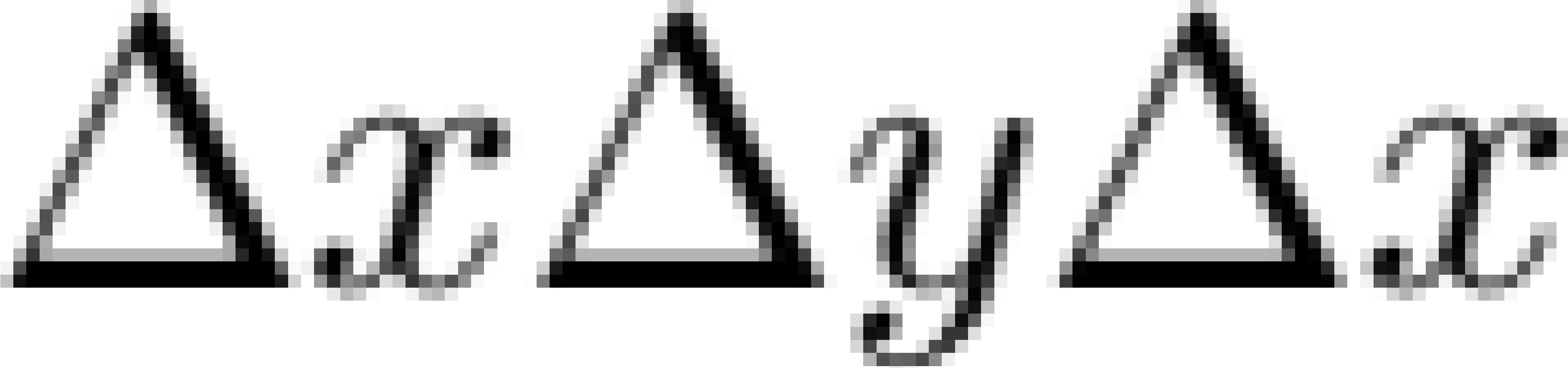
$$\Sigma F_z = +\underline{F}_1 - \underline{F}_2 = 0$$

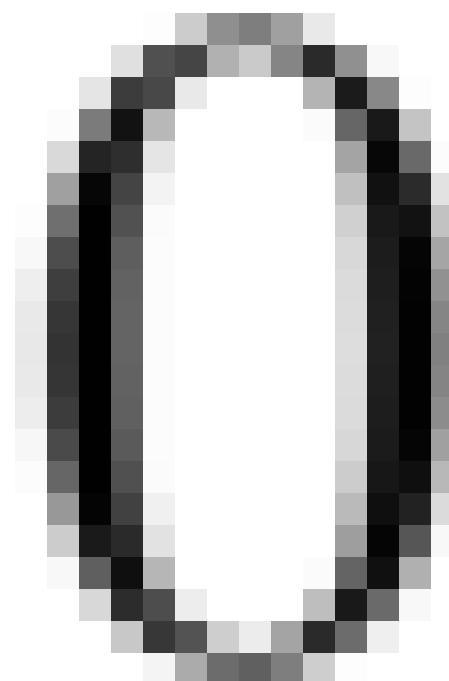
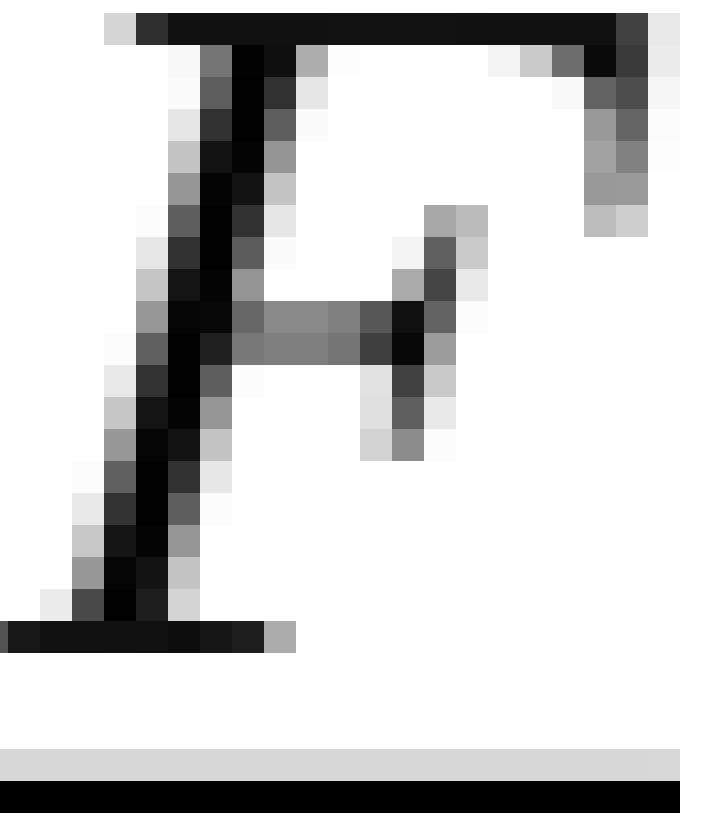
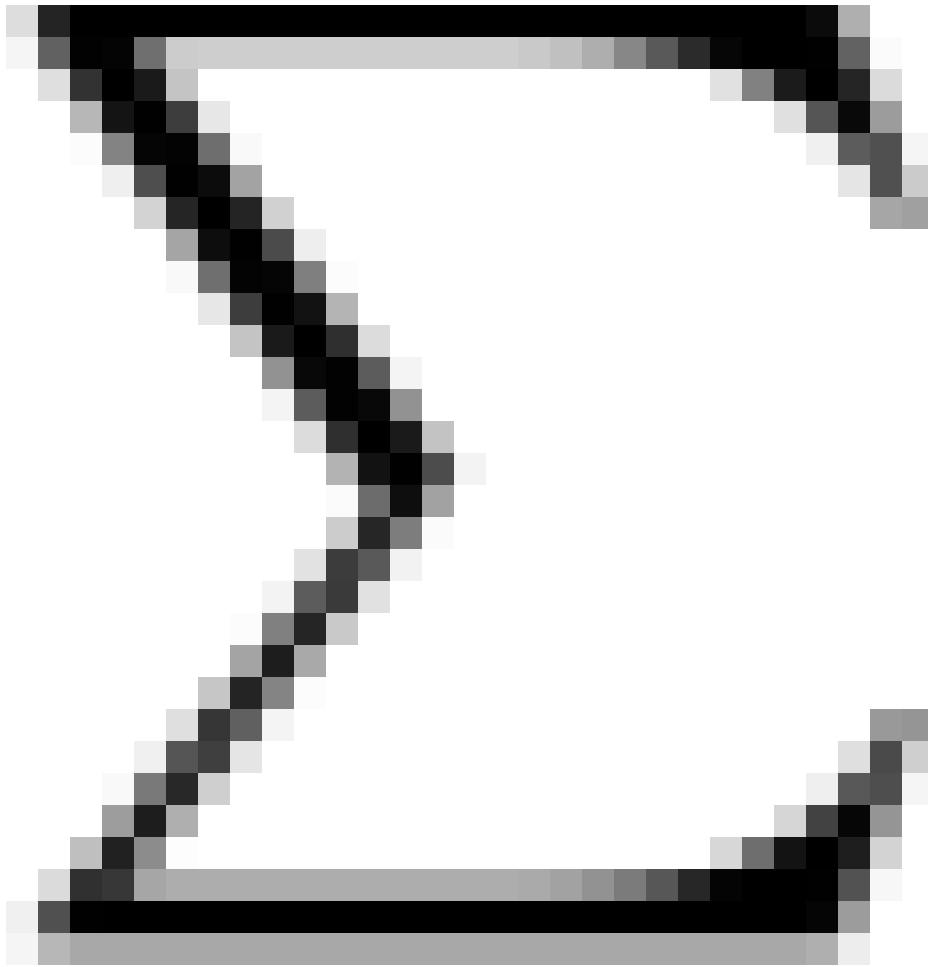


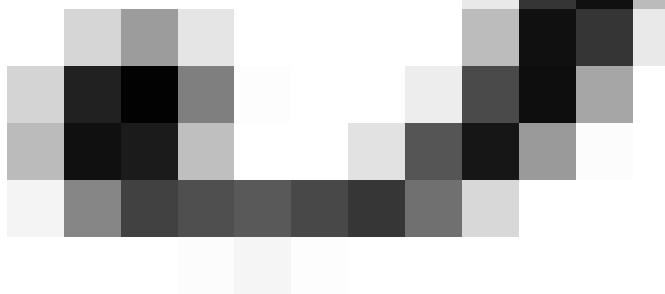
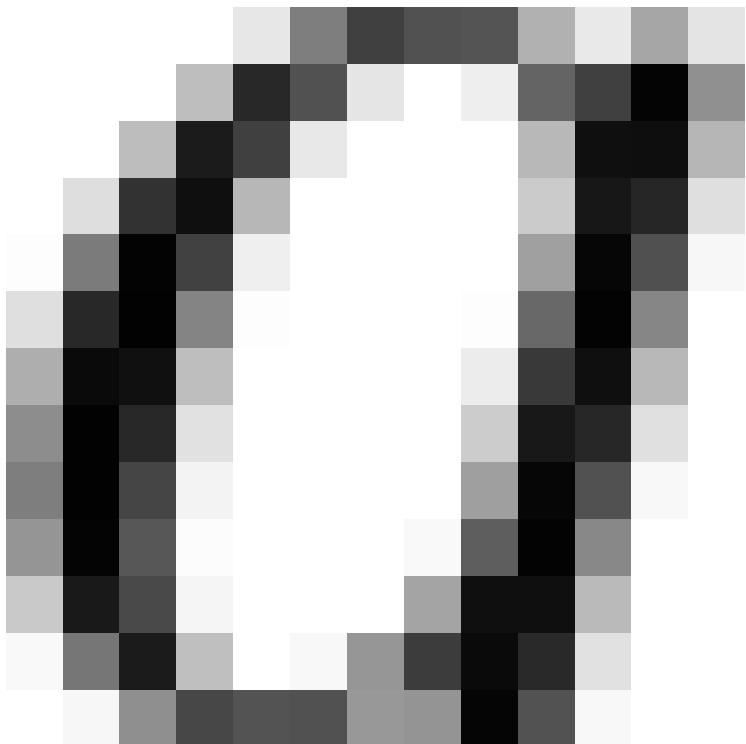
$$\Sigma F_z = +\underline{F}_1 - m g - \underline{F}_2$$

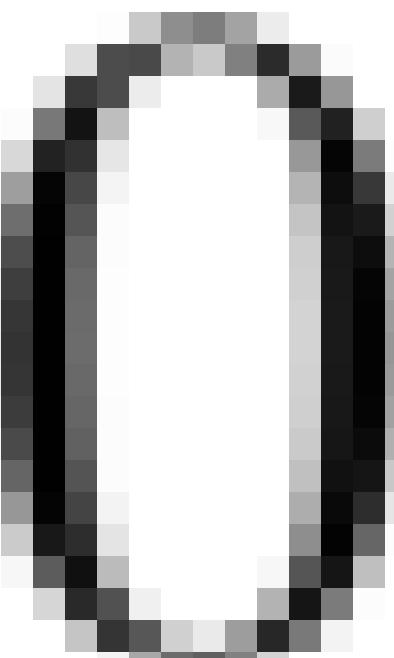
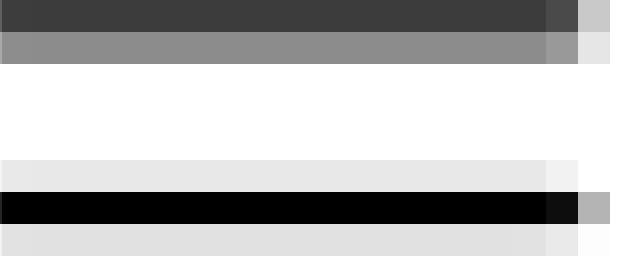
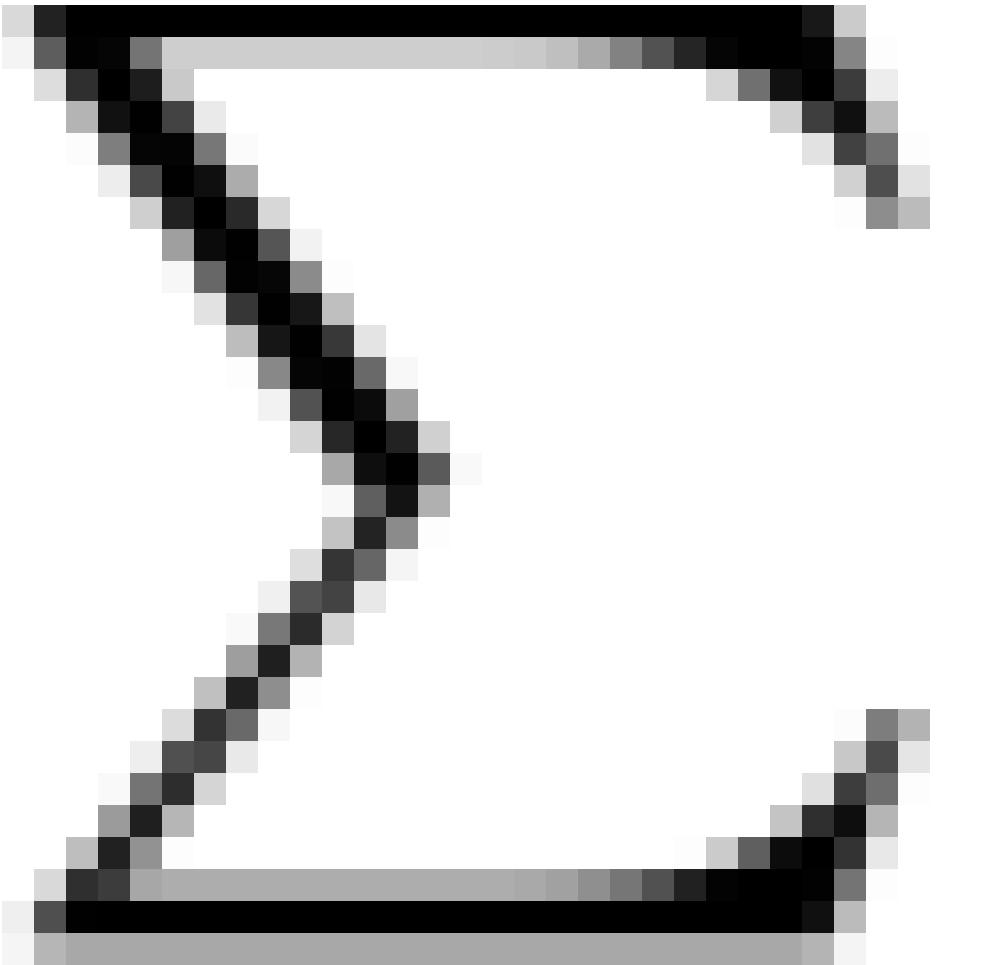


$$\Sigma F_z = +\underline{\sigma}_1 A - (\rho A L)g - \underline{\sigma}_2 A$$











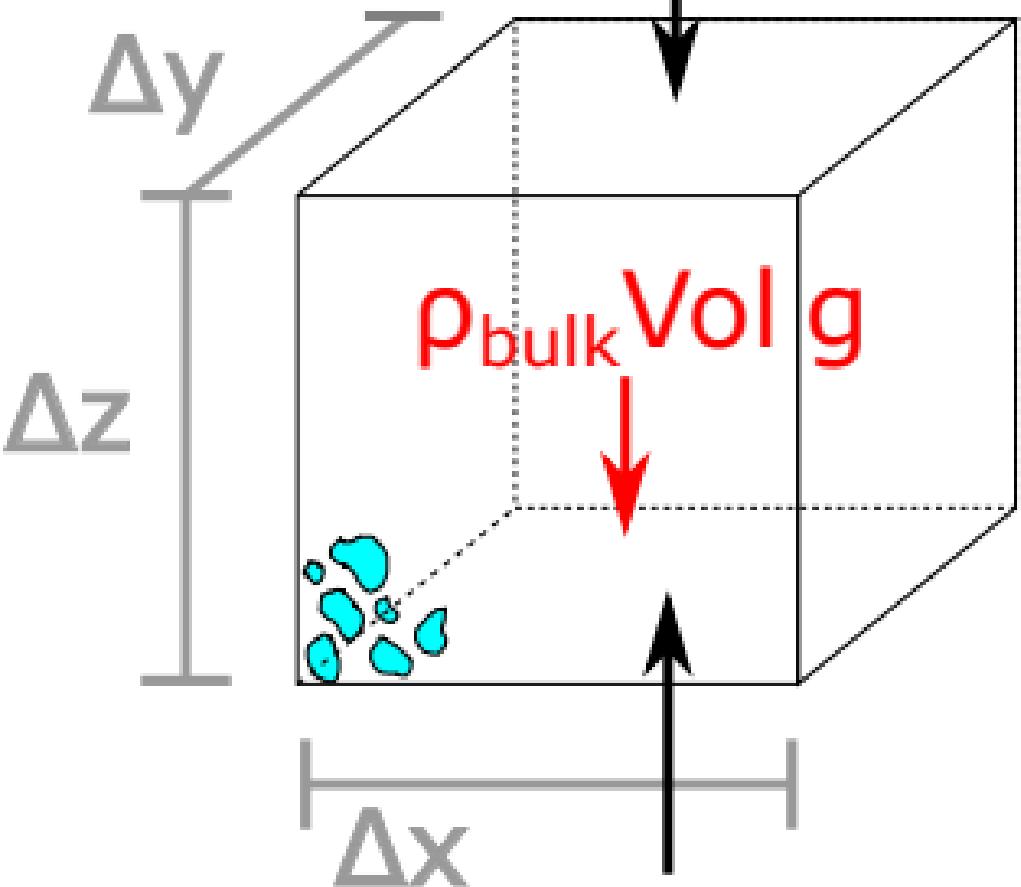


△ S₂

△ z

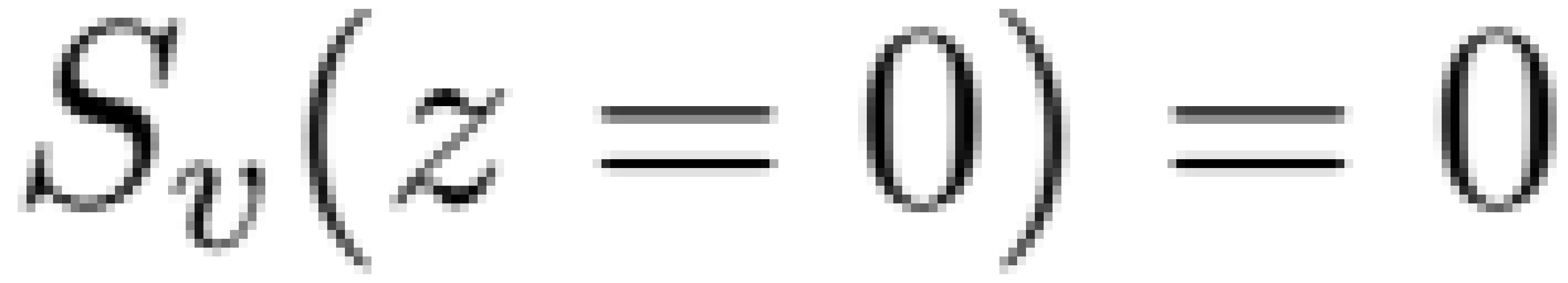
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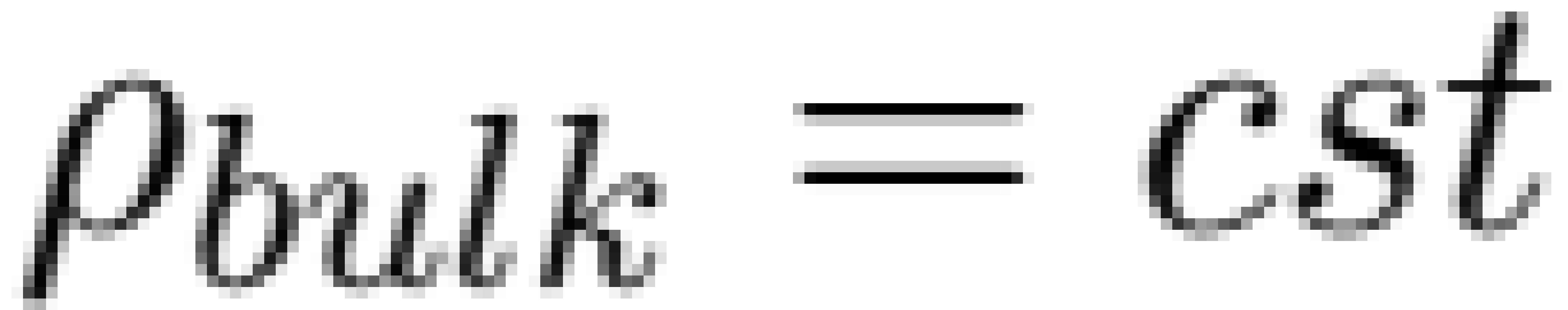
Observe 9

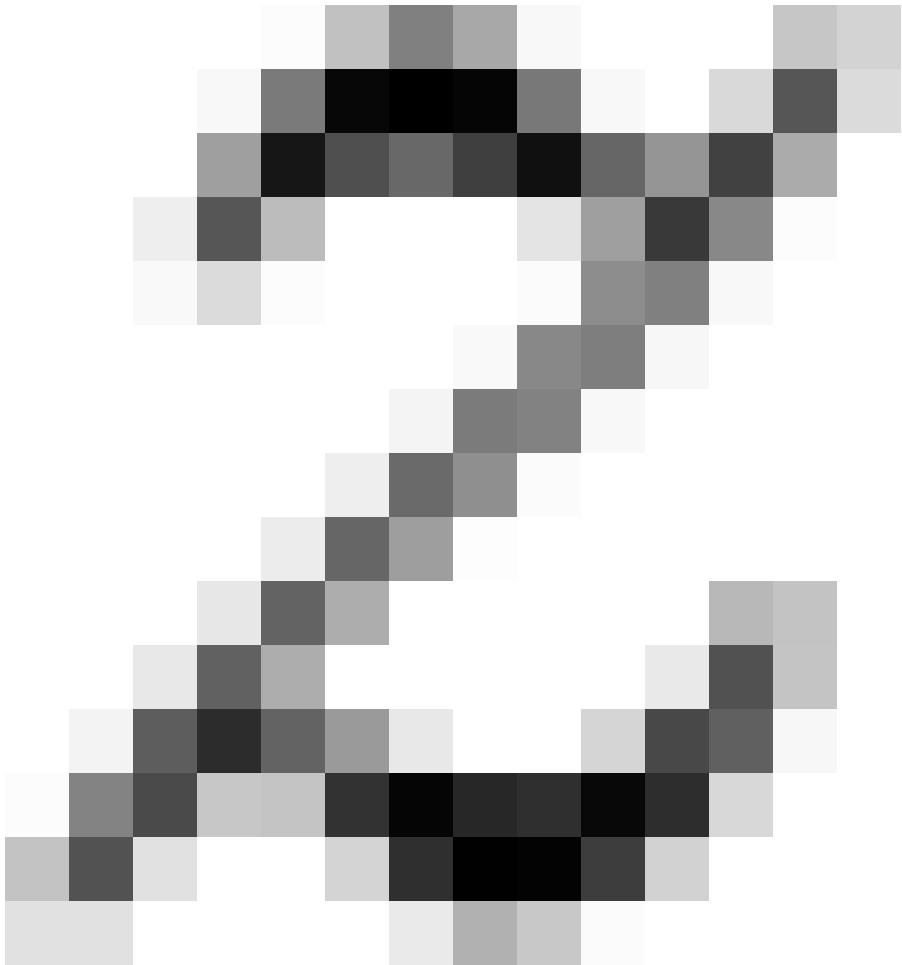
$S_v A$  $S_v A + \Delta S_v A$

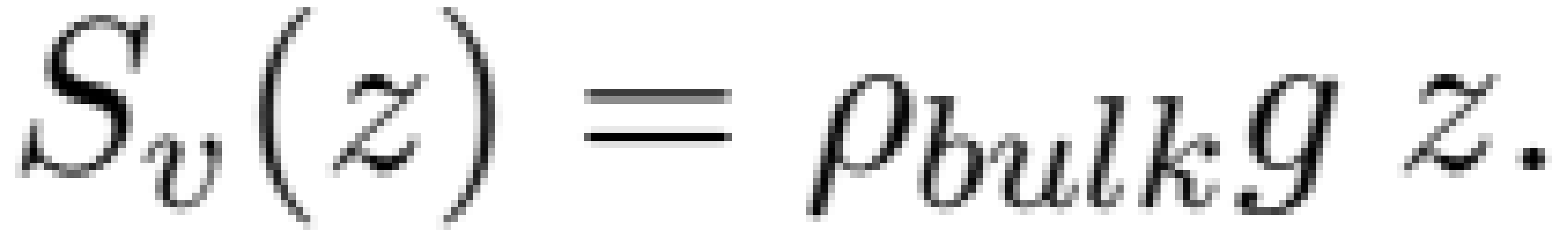
$$\int_0^{S_w(z)} ds_w = \int_0^z \rho_{bulk}(z) q dz$$







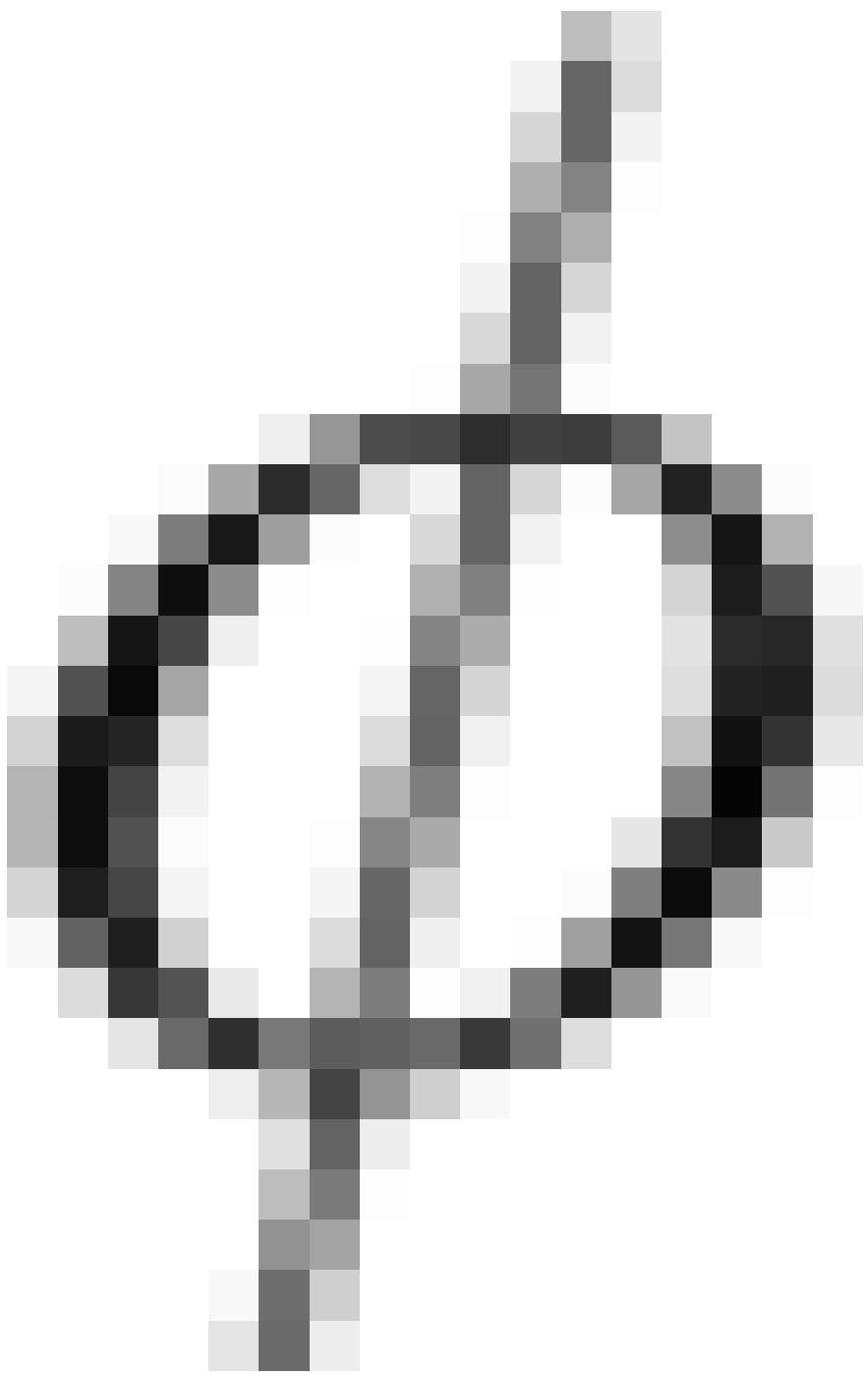


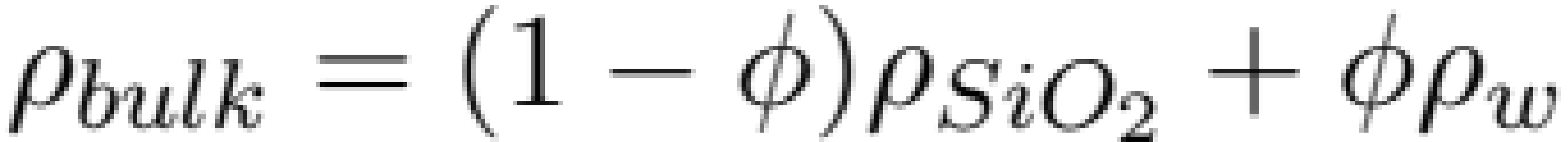


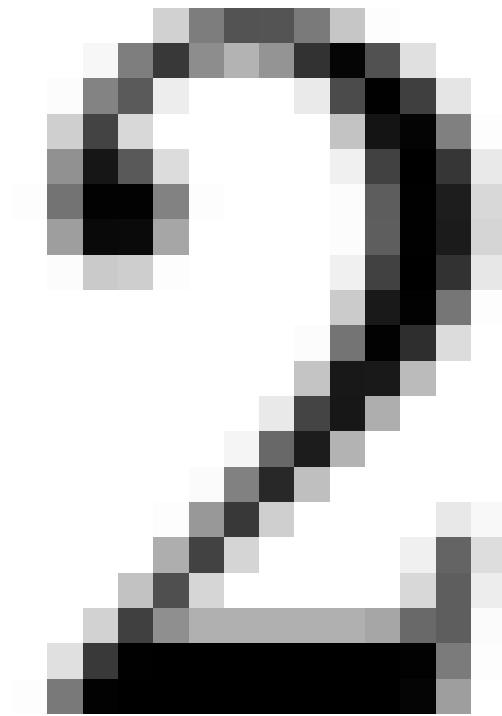
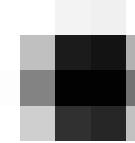
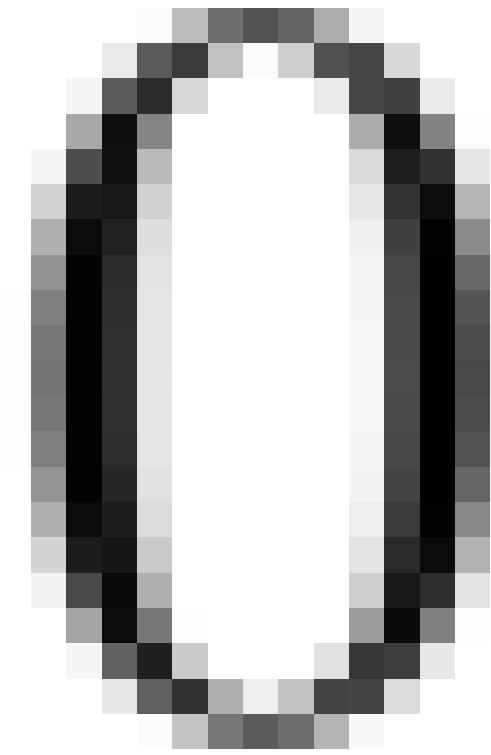
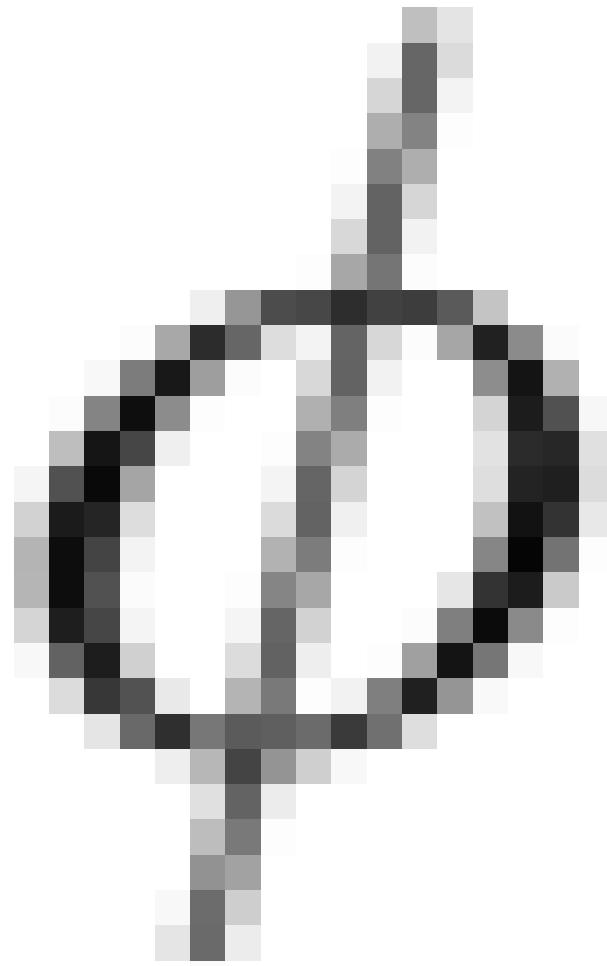




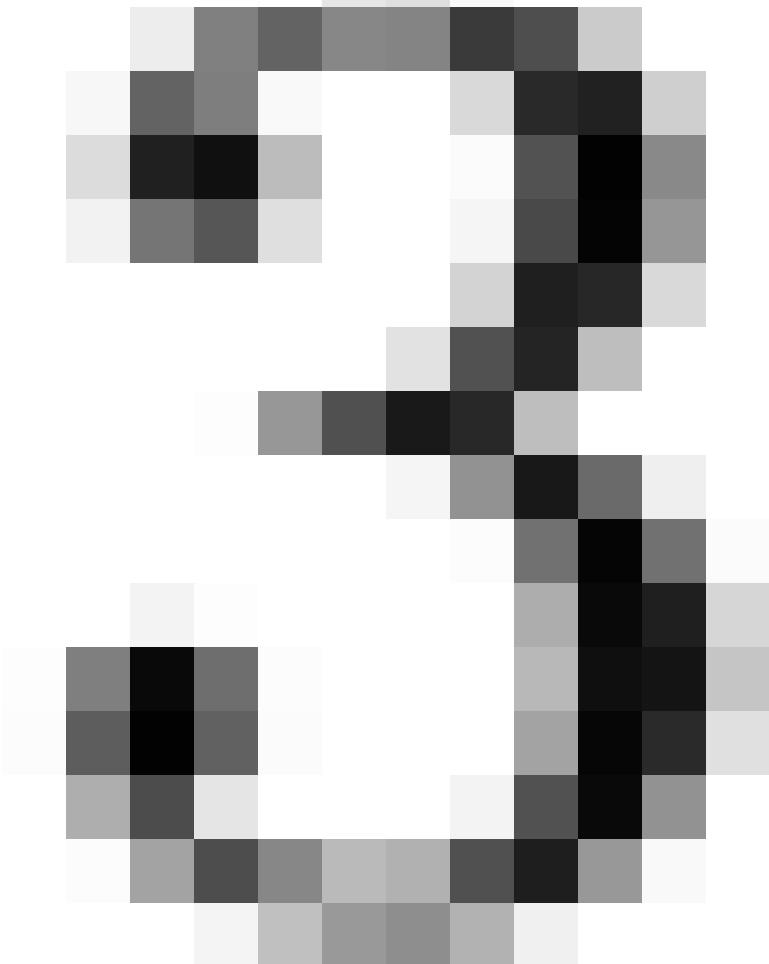


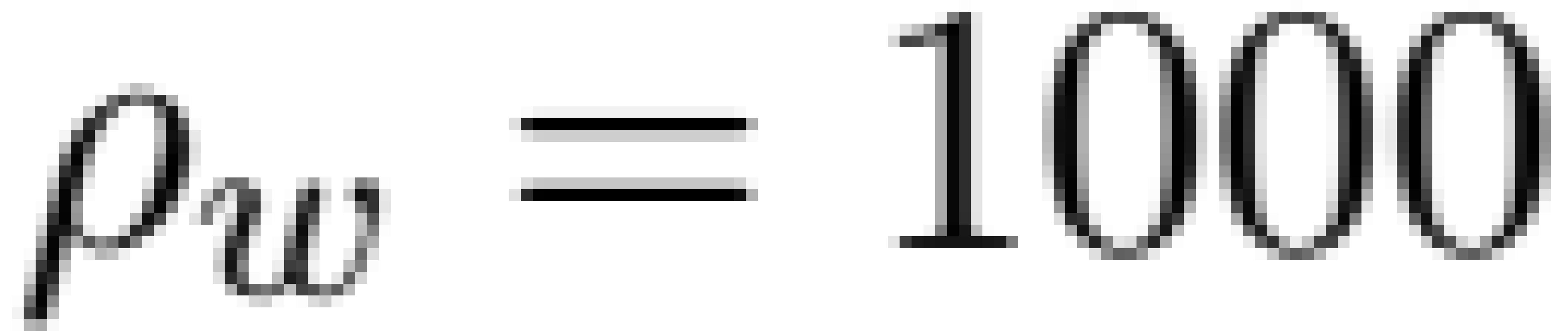


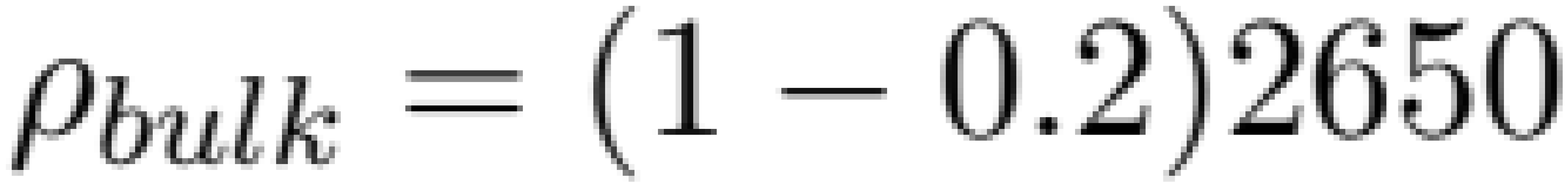






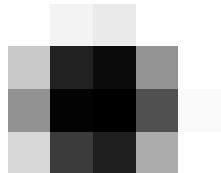
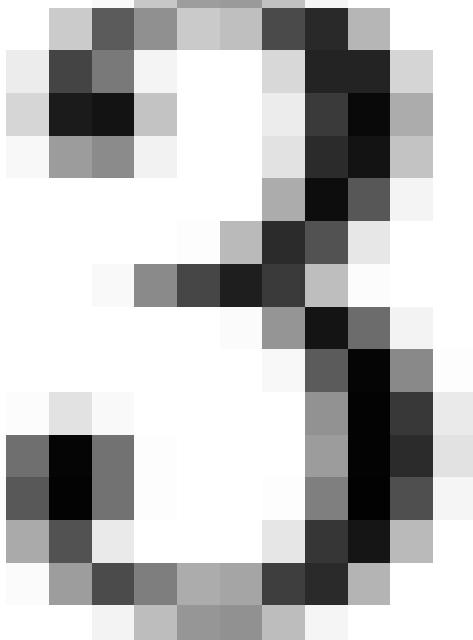


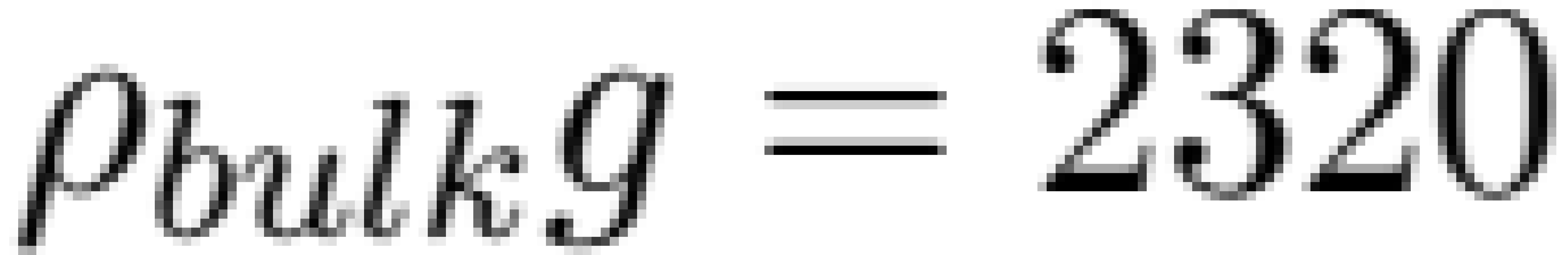


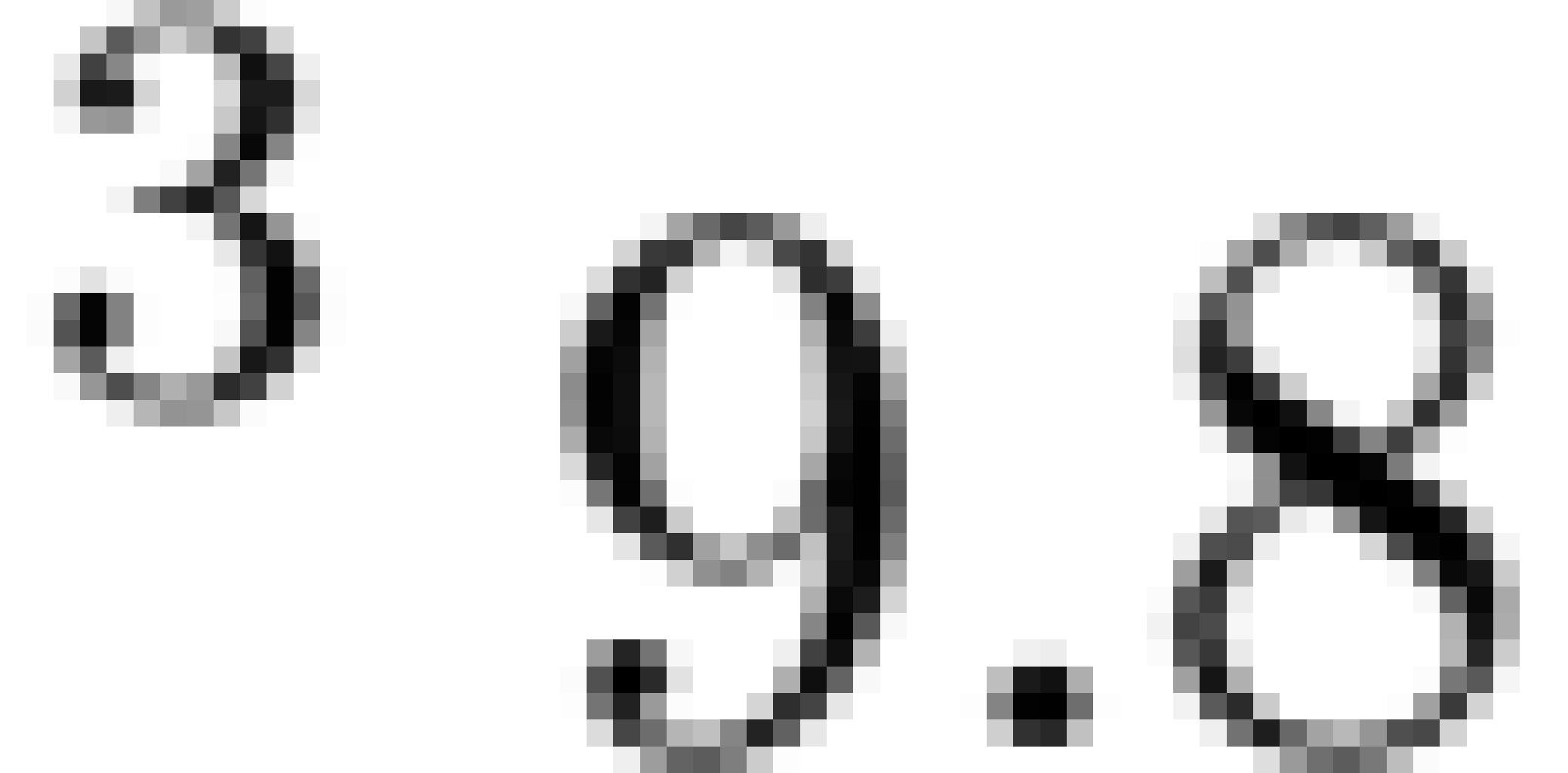


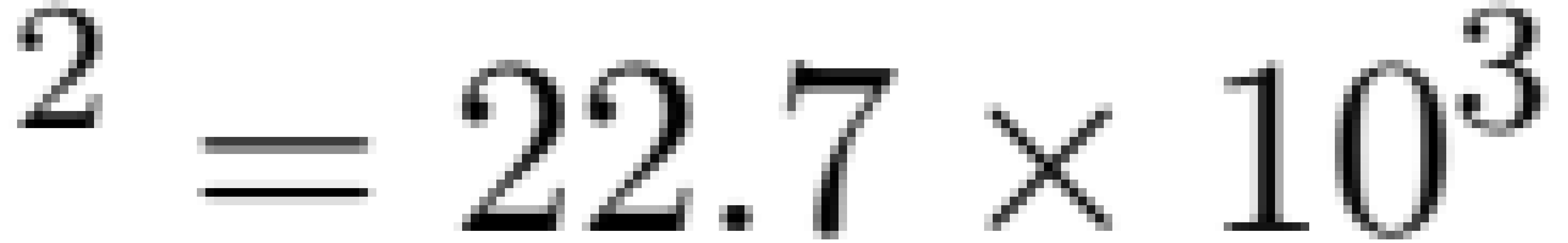


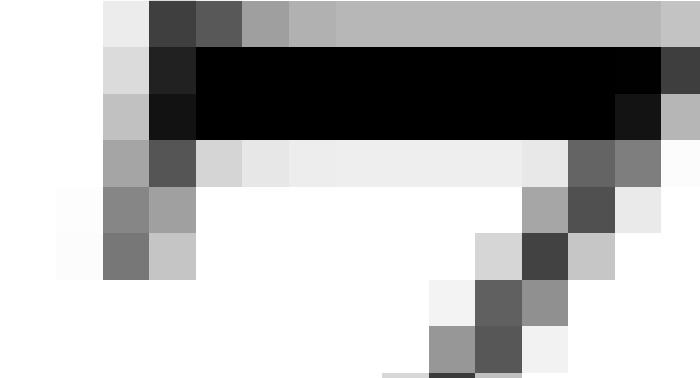
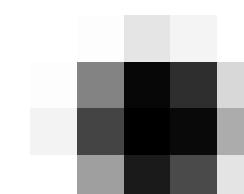
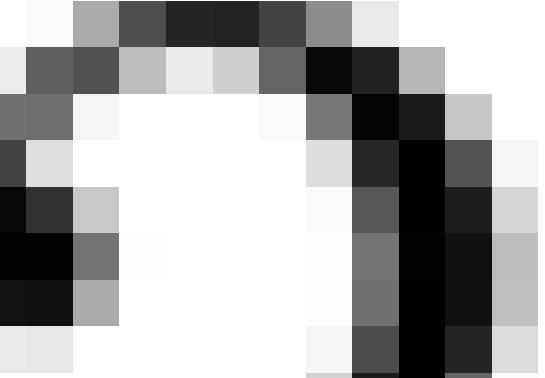
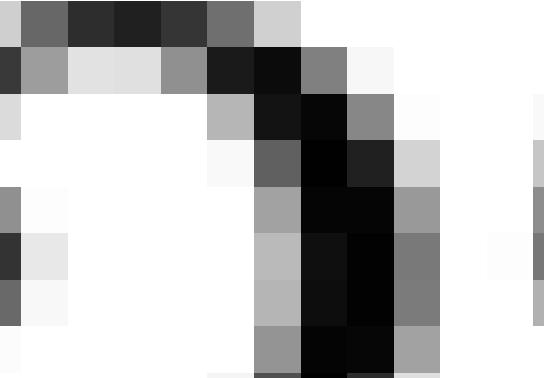


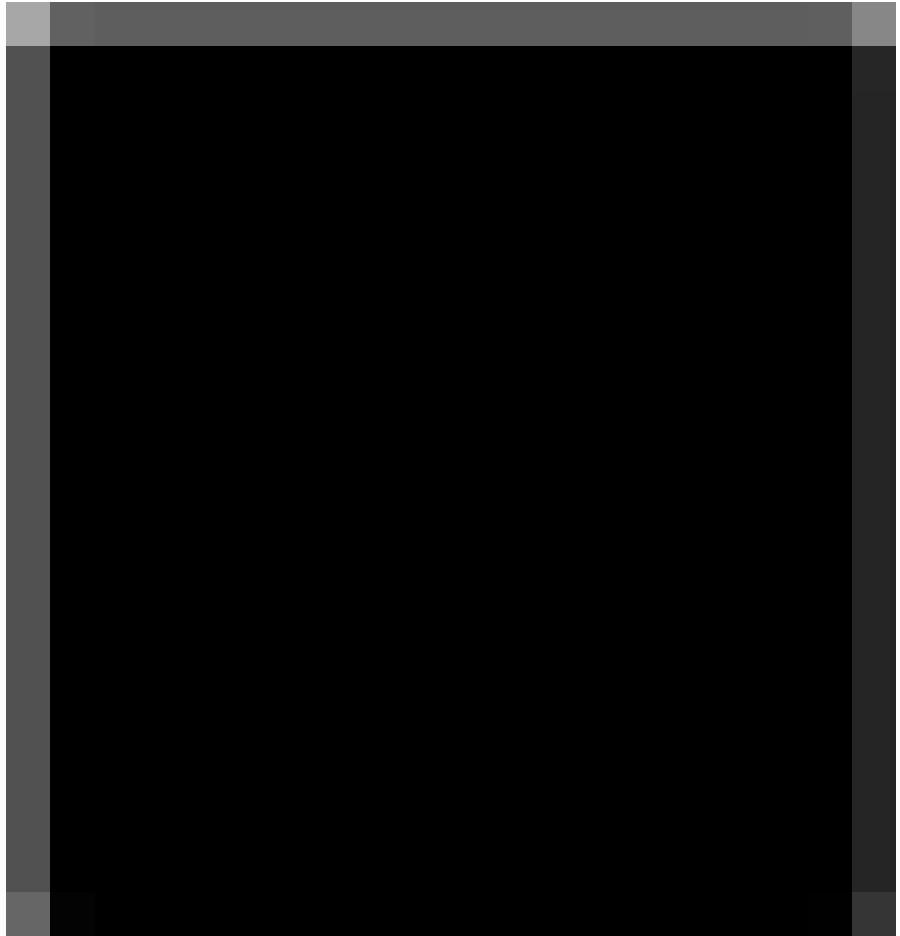
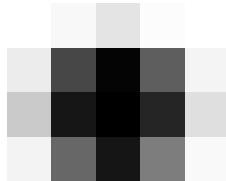


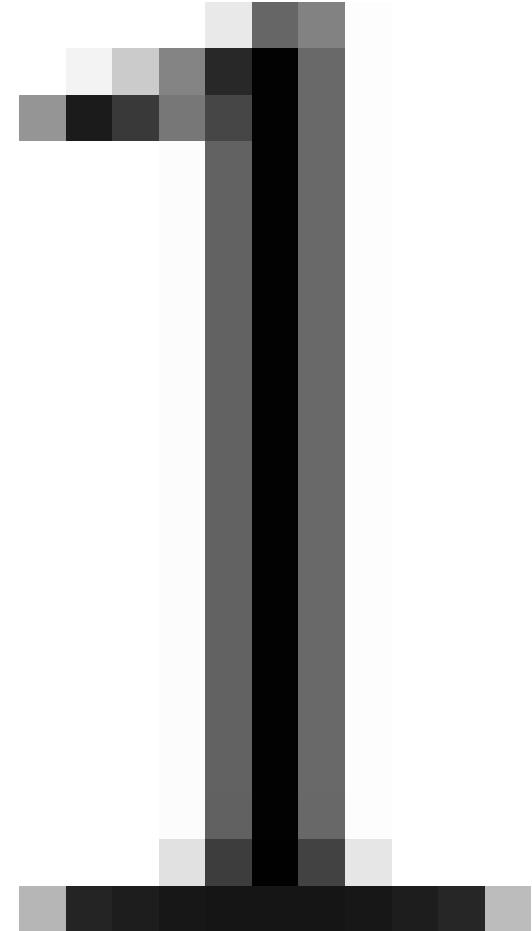
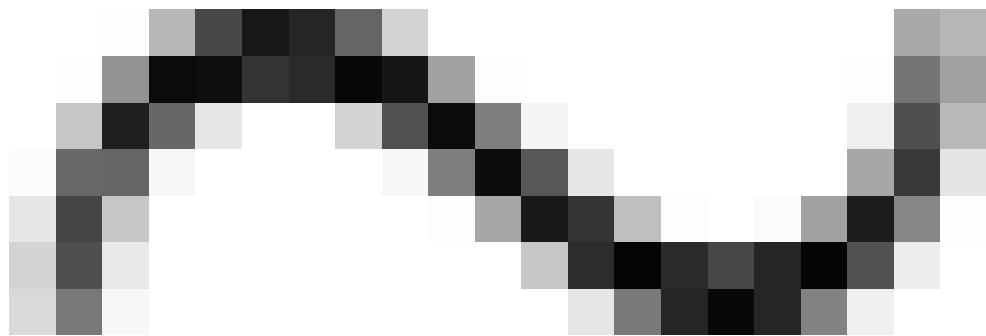


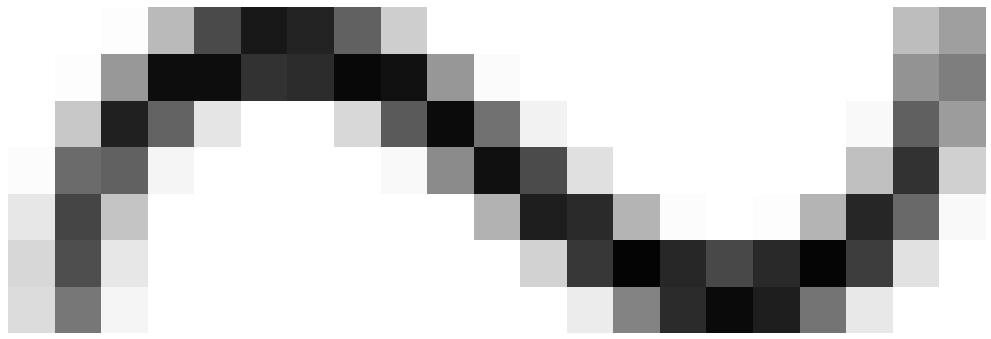


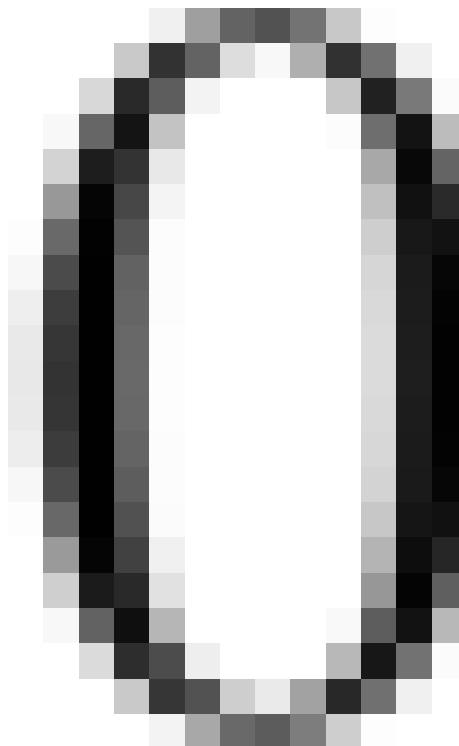
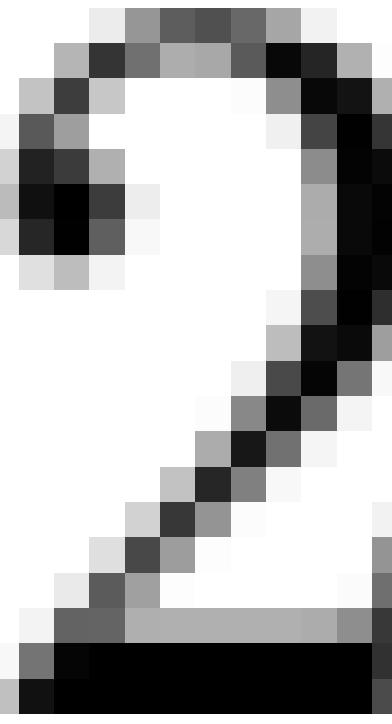
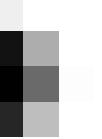
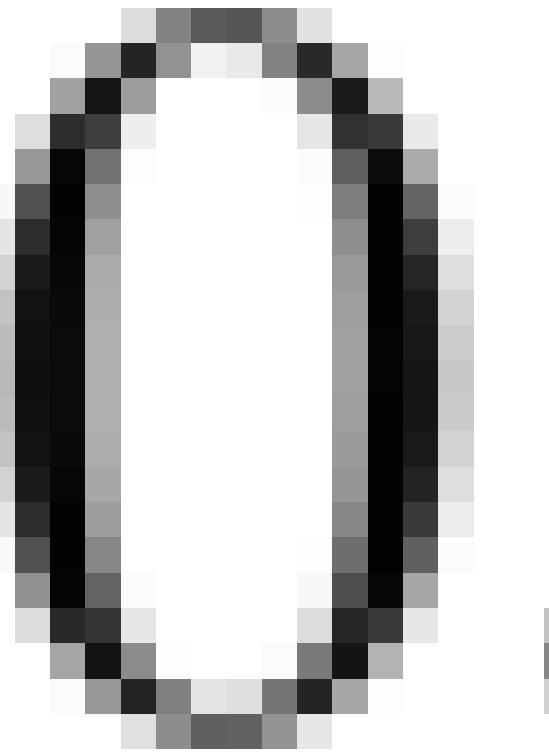
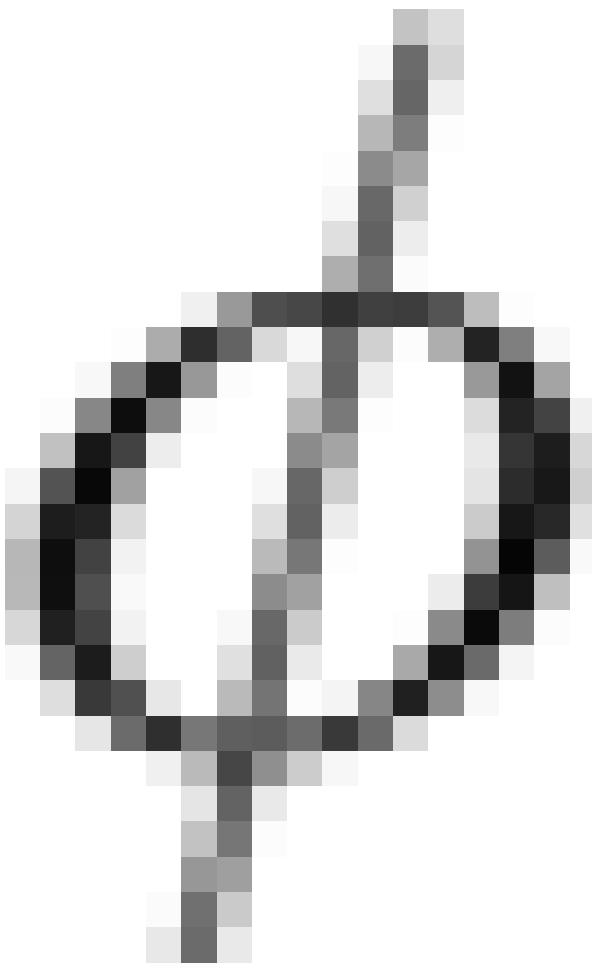


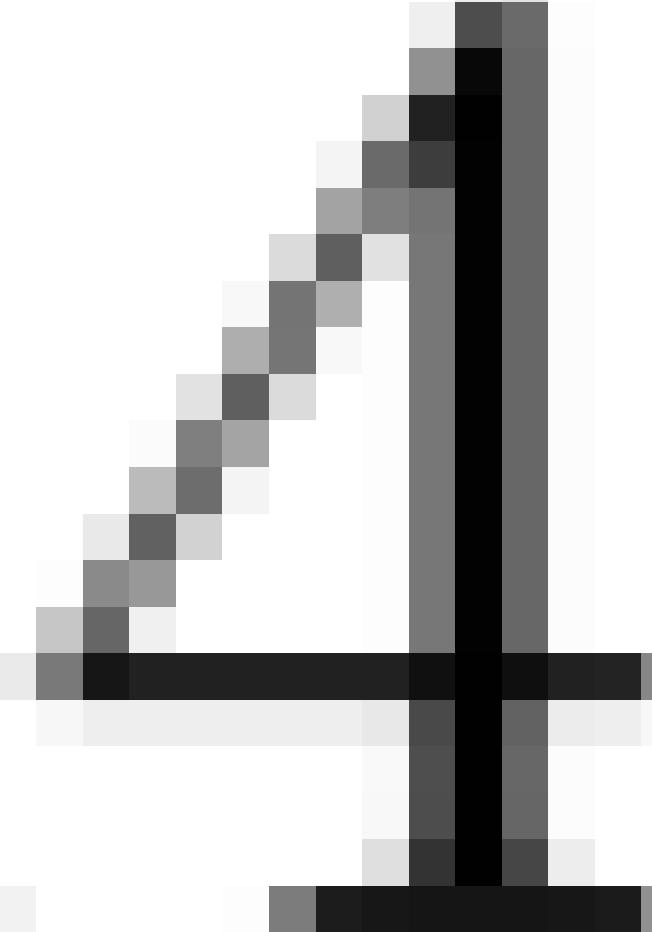
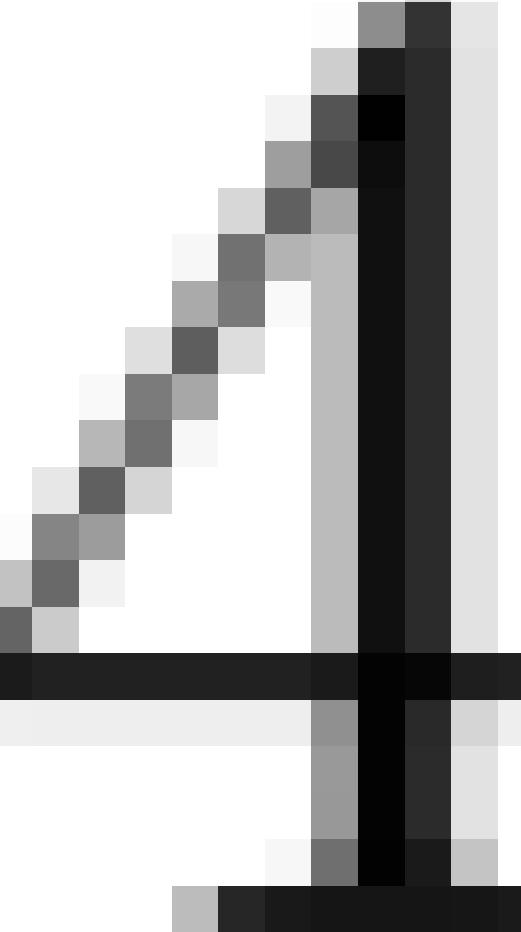
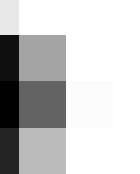
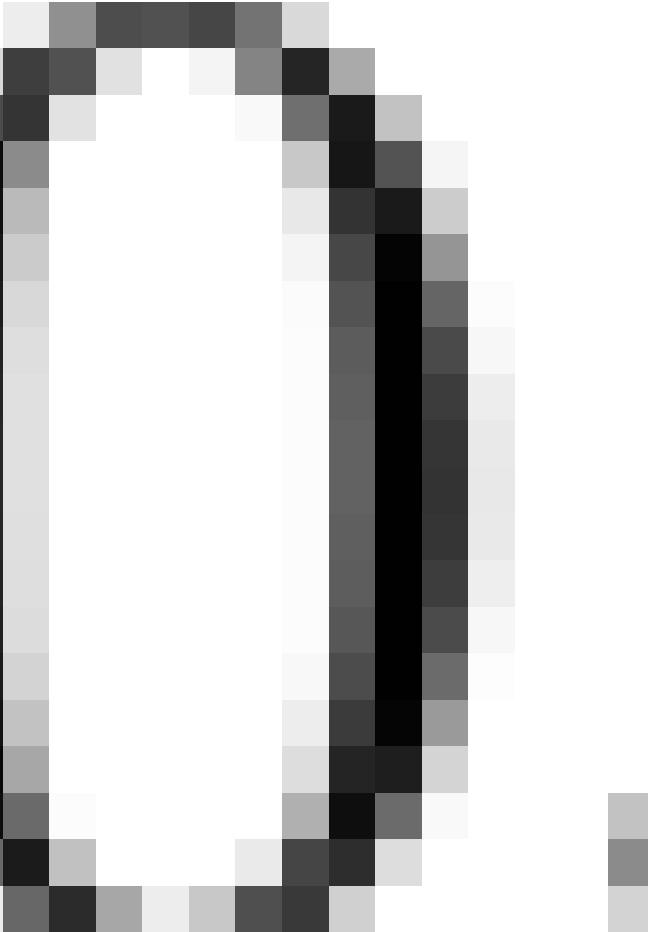
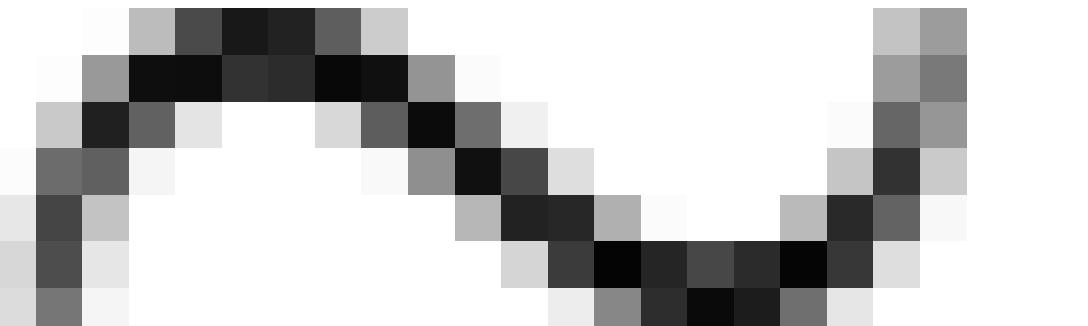


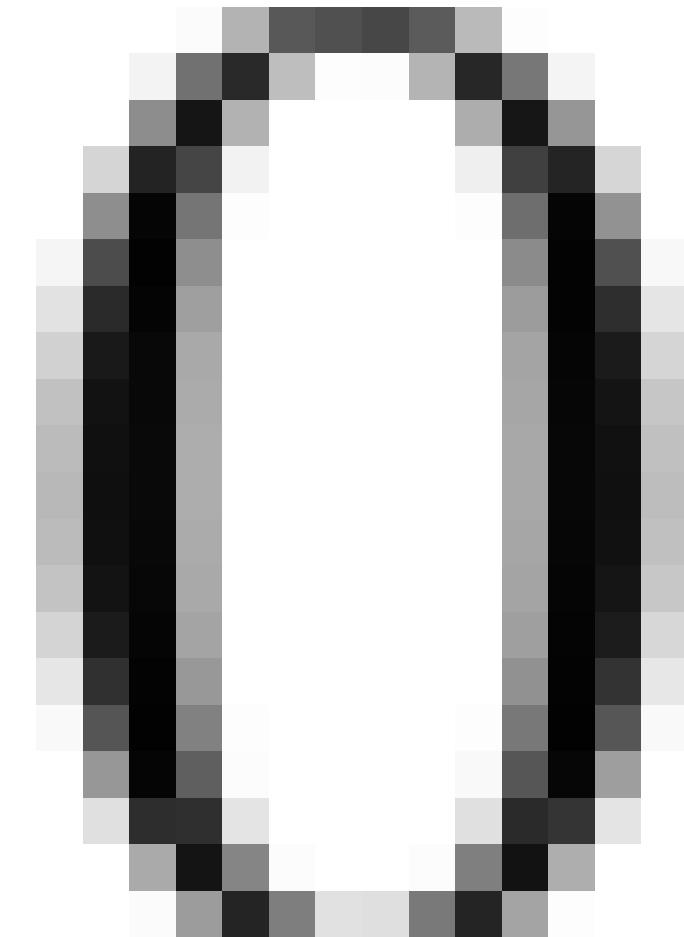
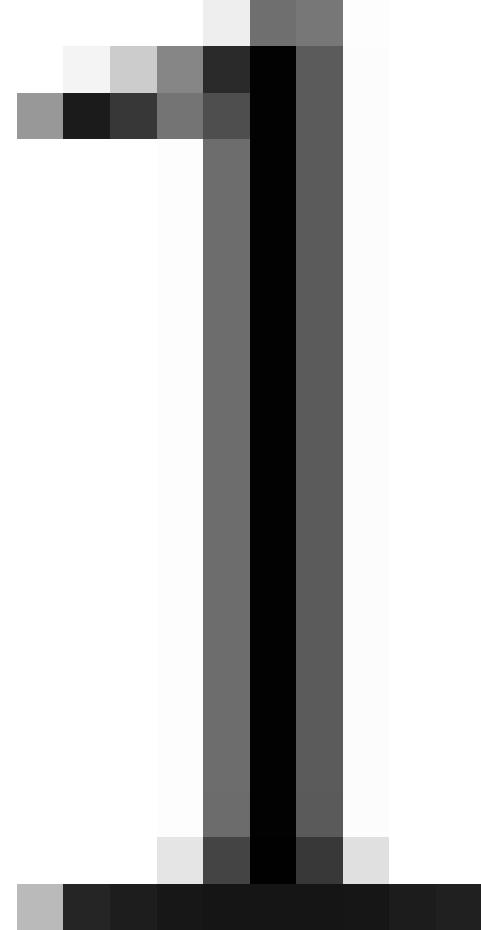
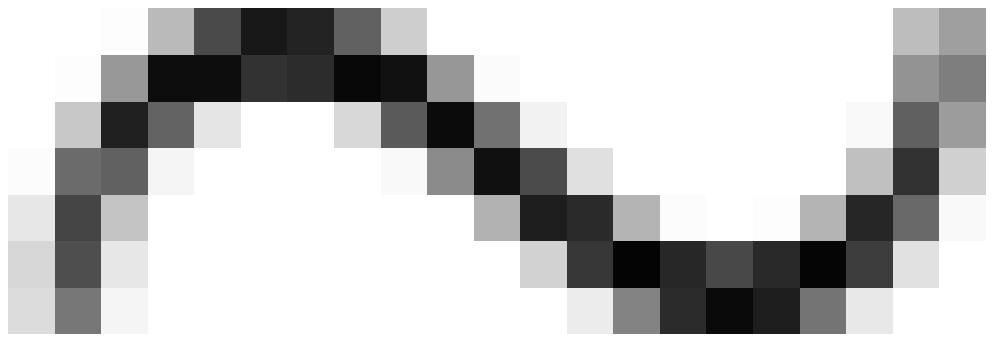




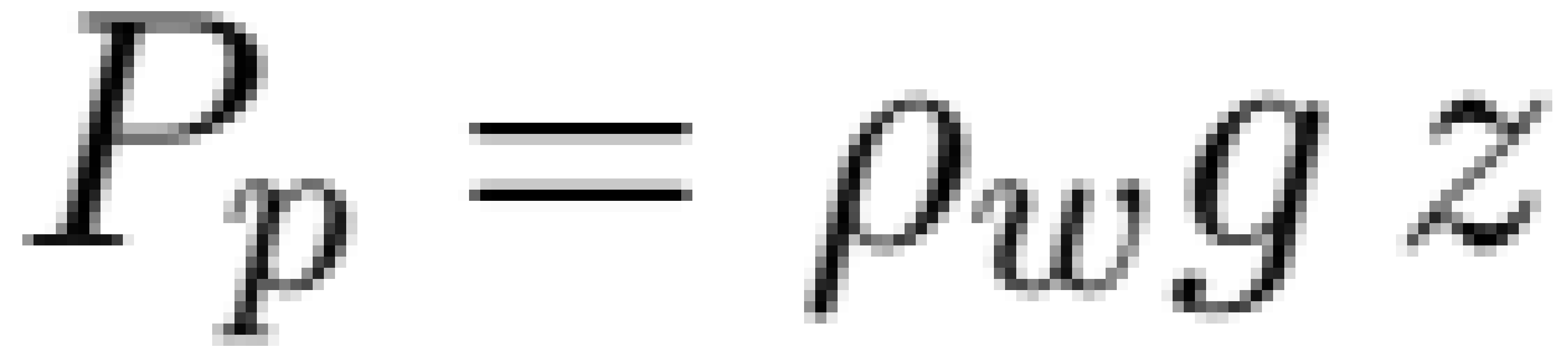




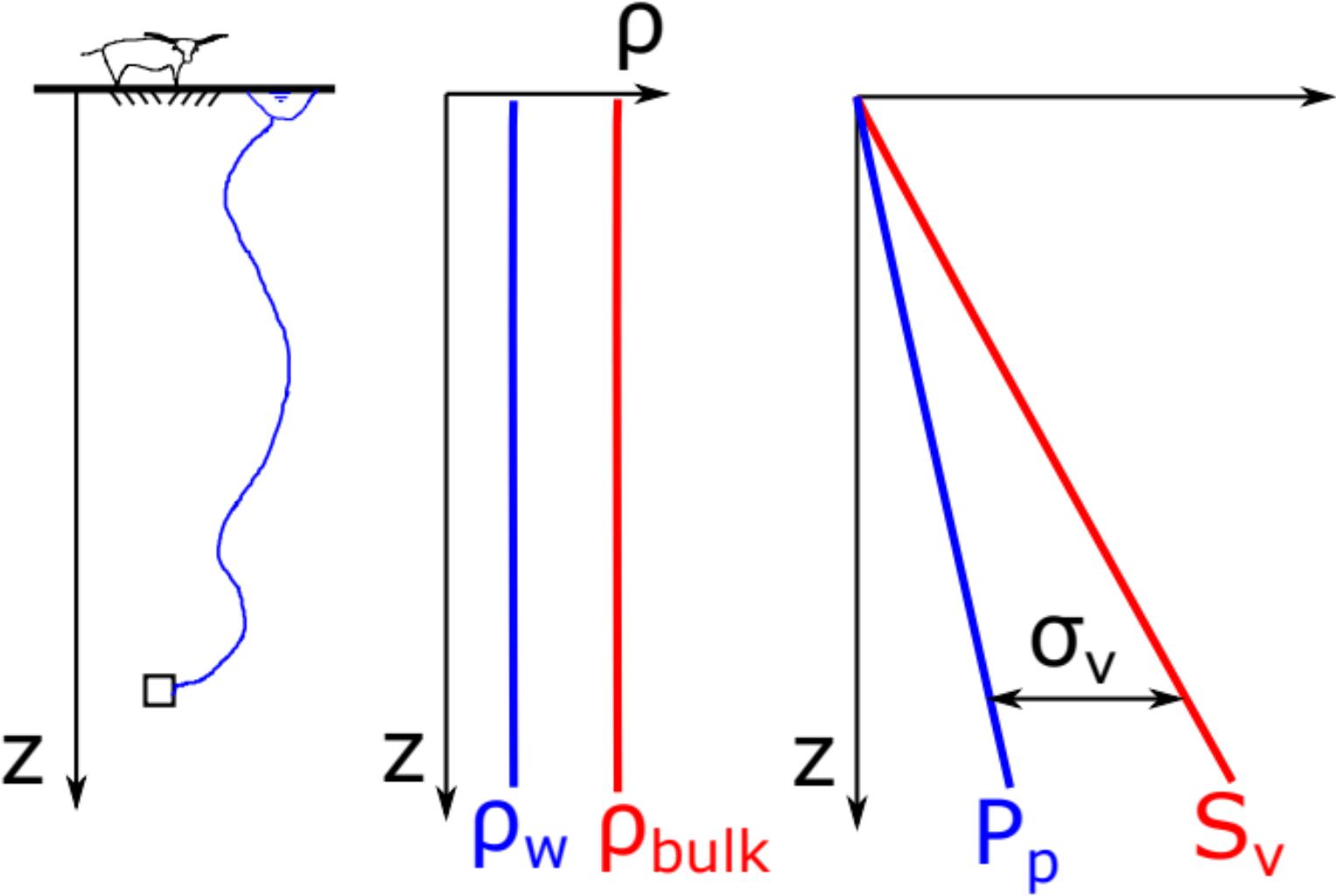










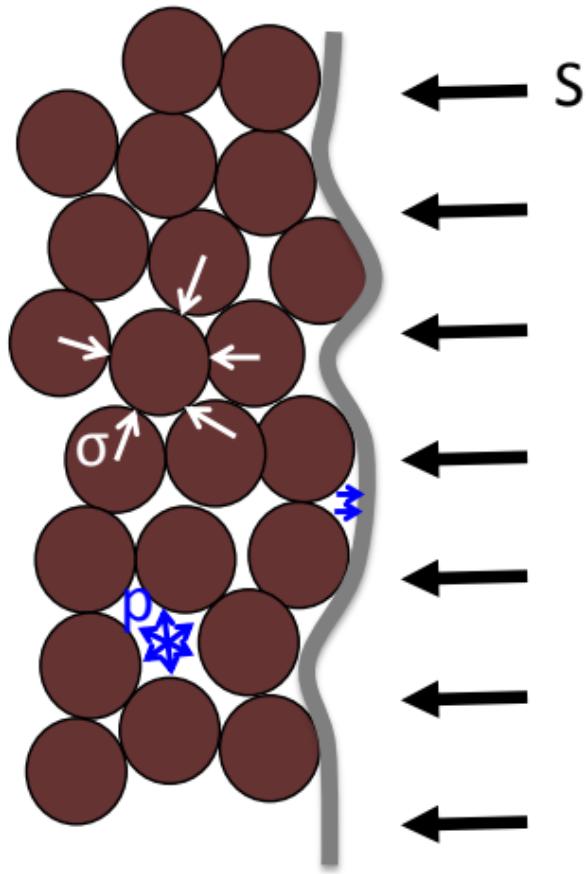




Effective stress =

Total stress – Pore pressure

$$\sigma = S - p$$





dP P $\rho_{w,9}$ 1040
 dz



dsu = Paulk 2350

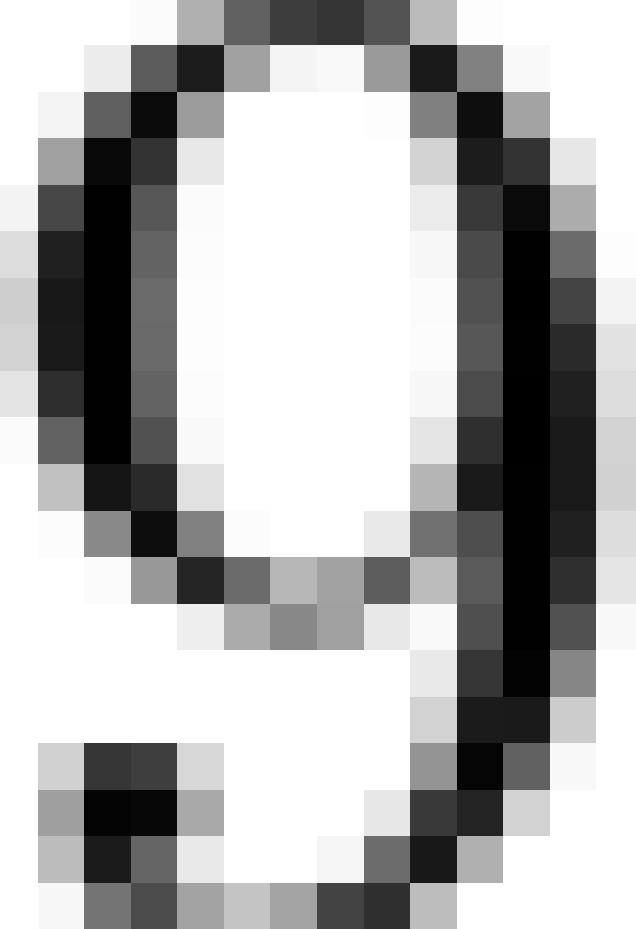
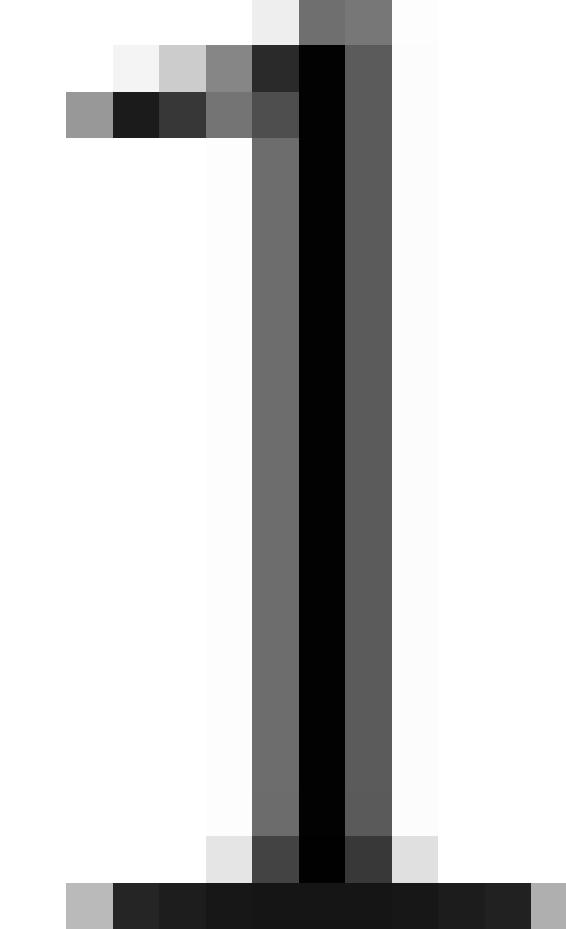
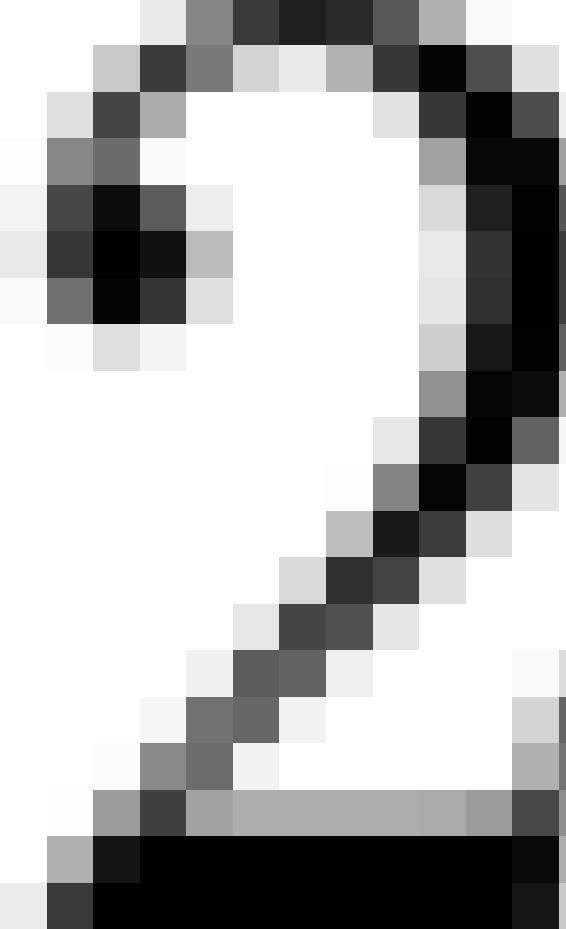
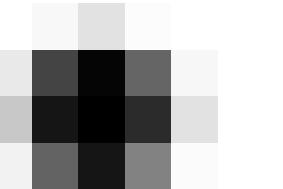
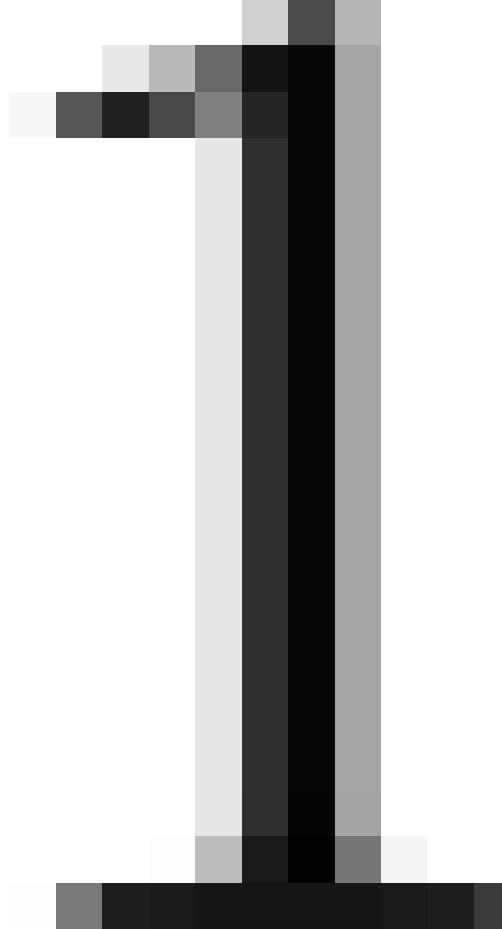


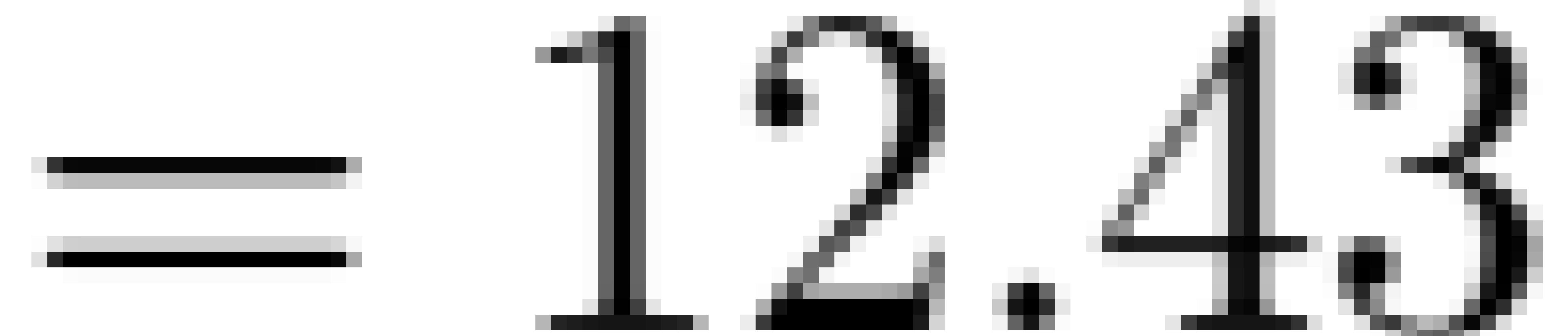
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P

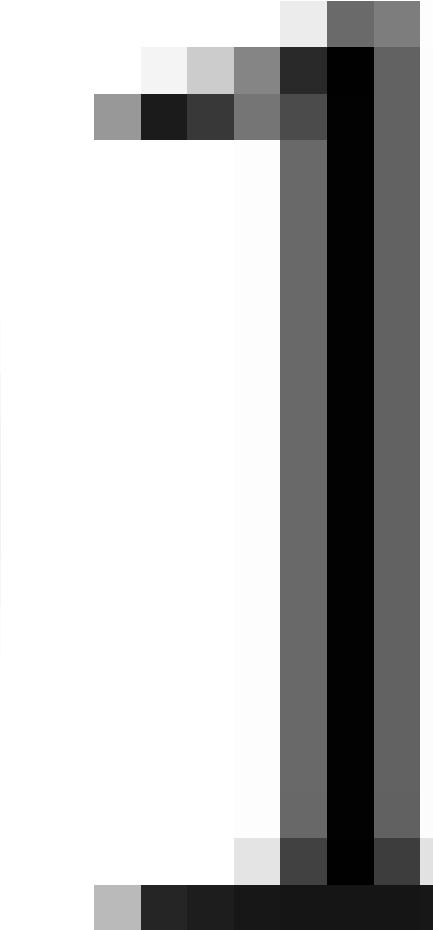
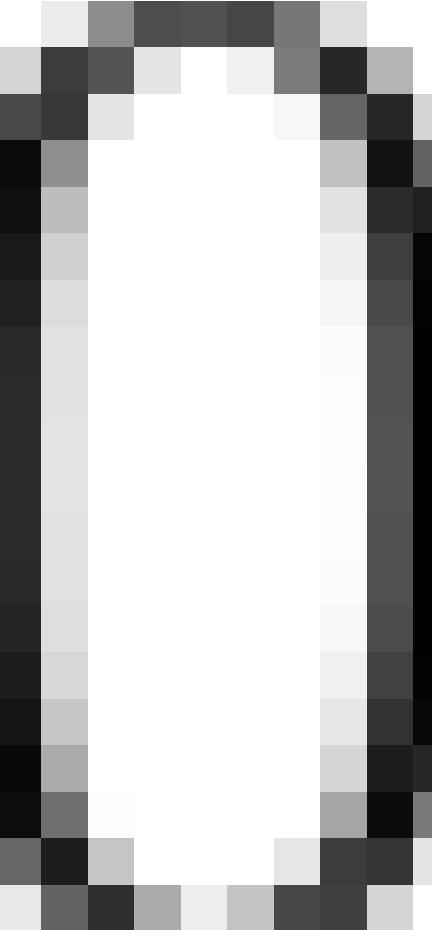
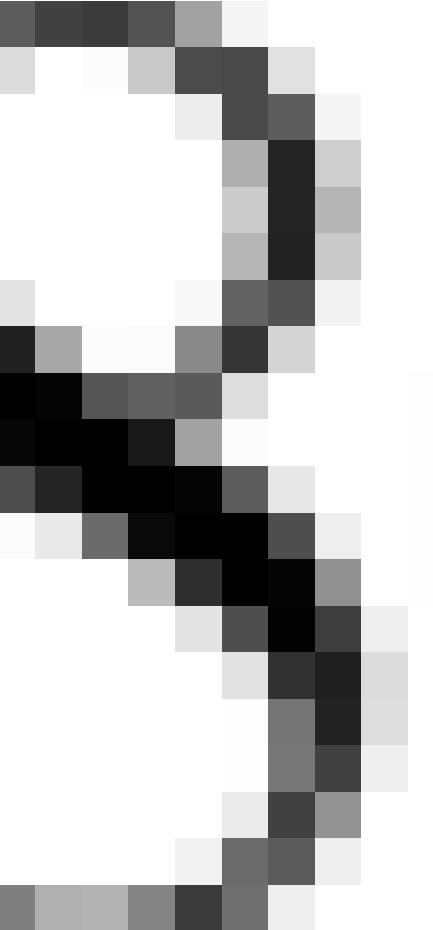
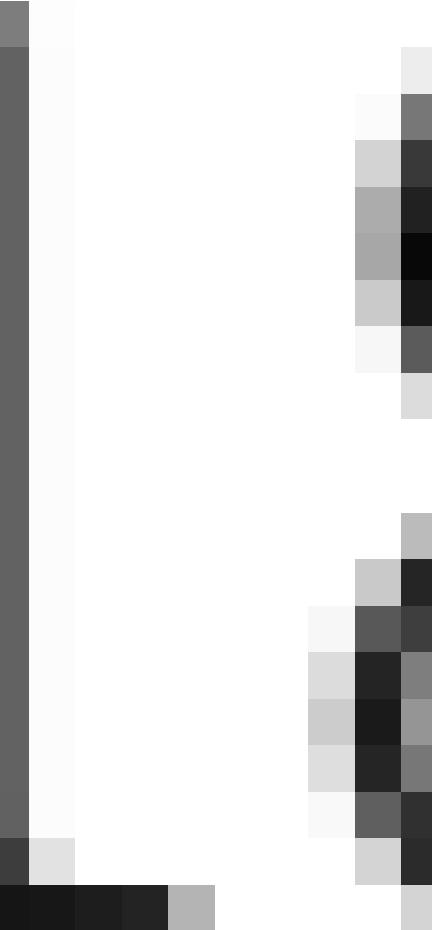
dP
dP
dZ
dZ

—
—

10.
19







d₅

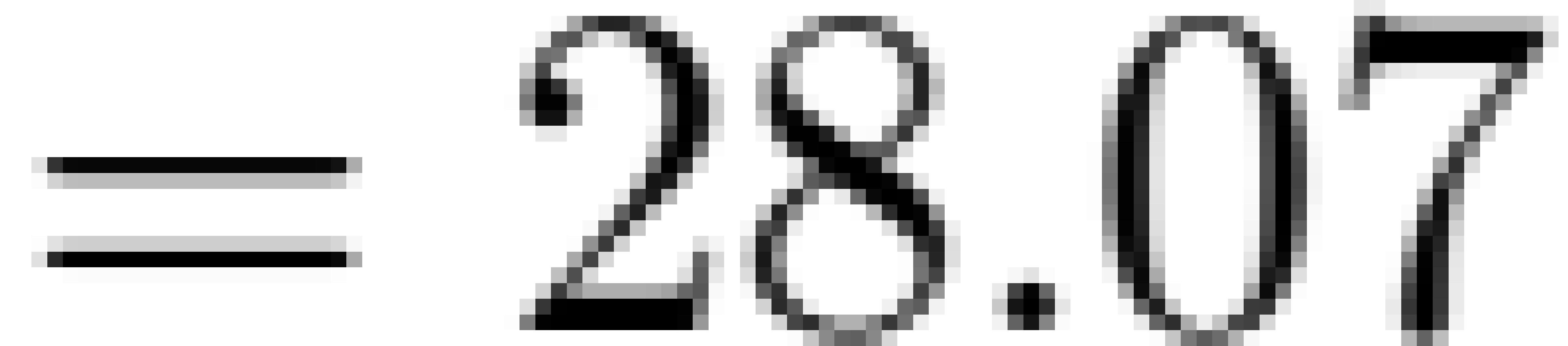
d₆

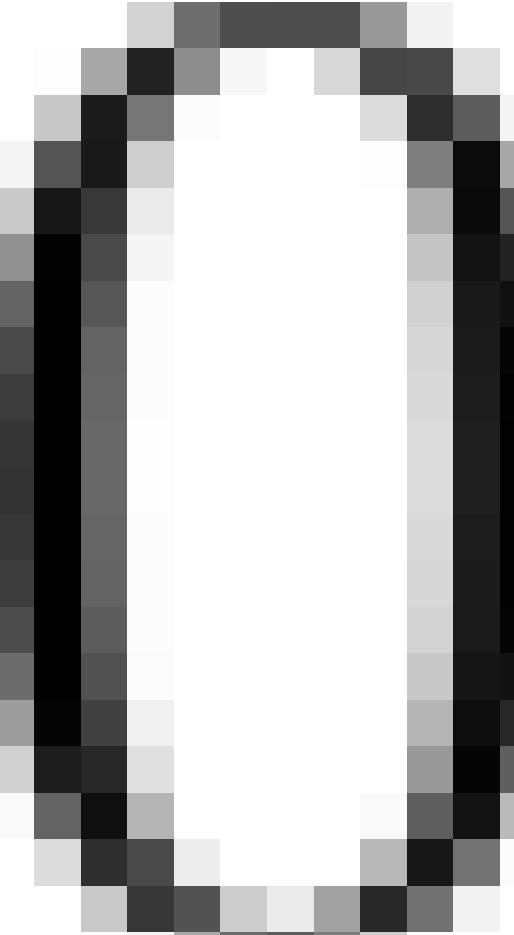
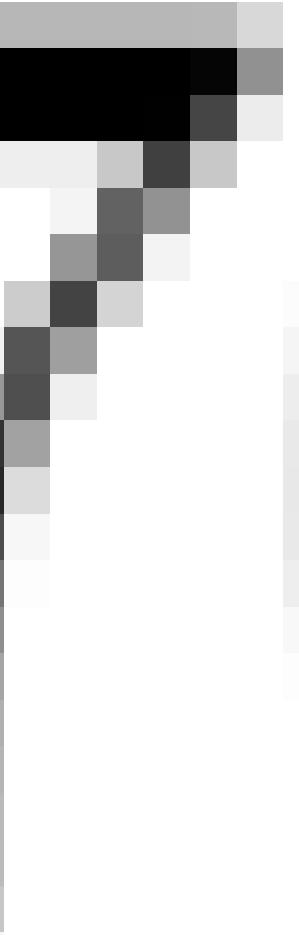
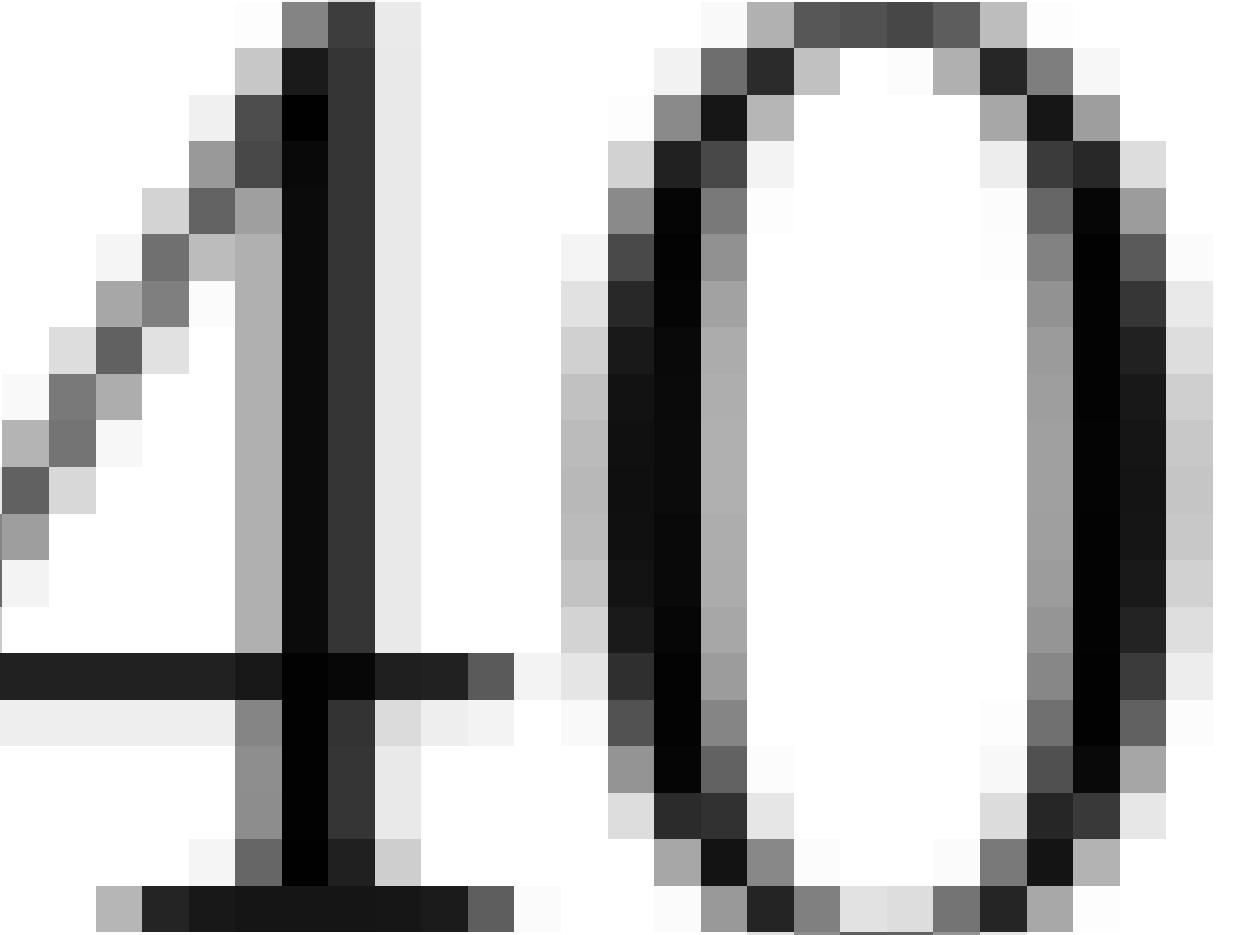
d₇

z

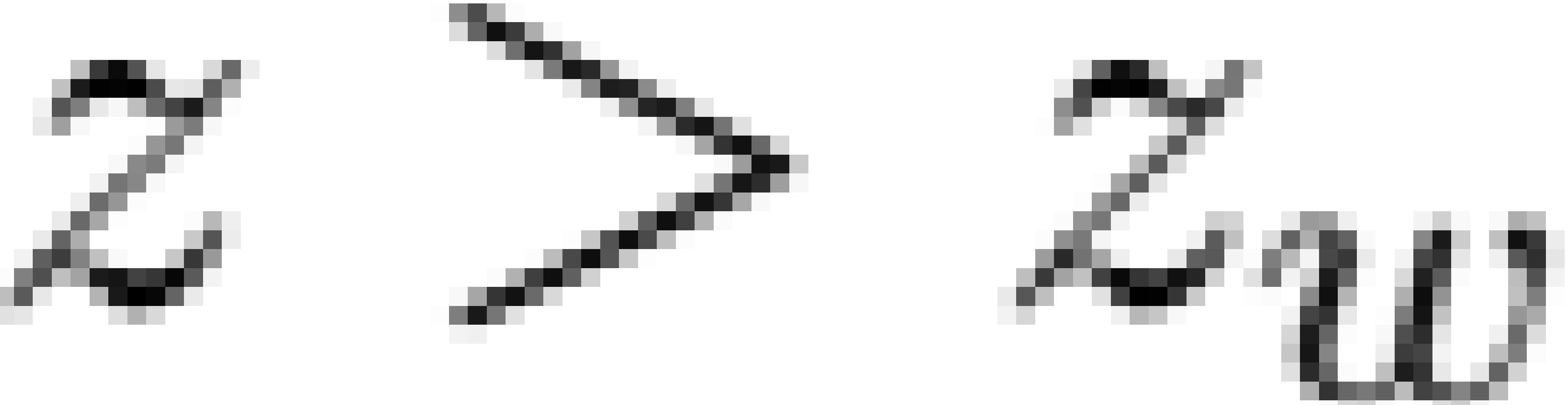
z

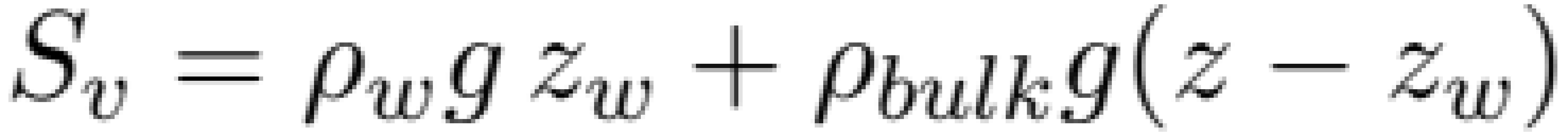
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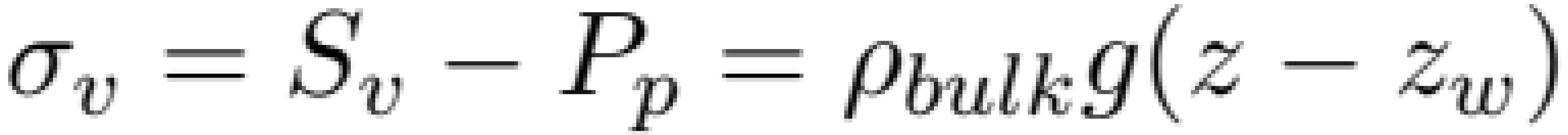


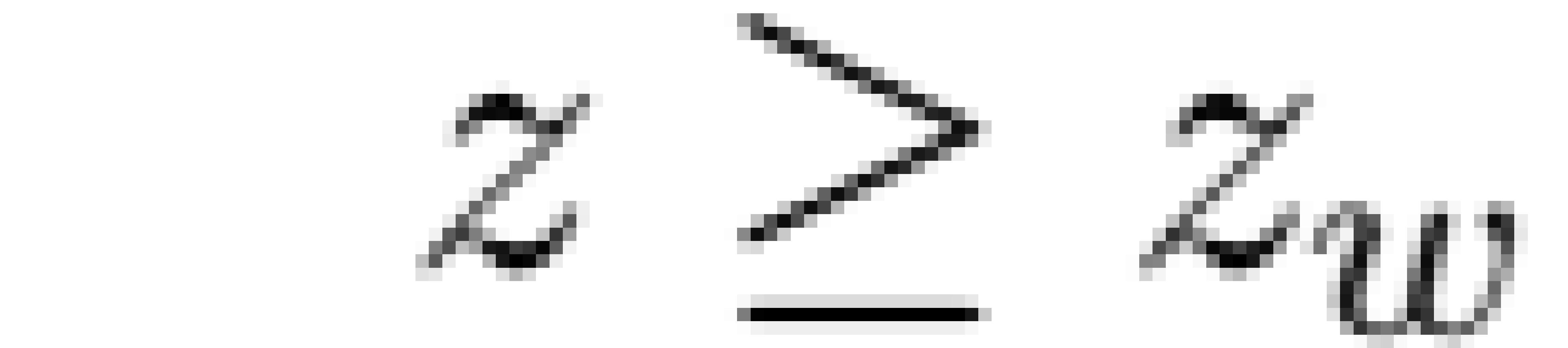


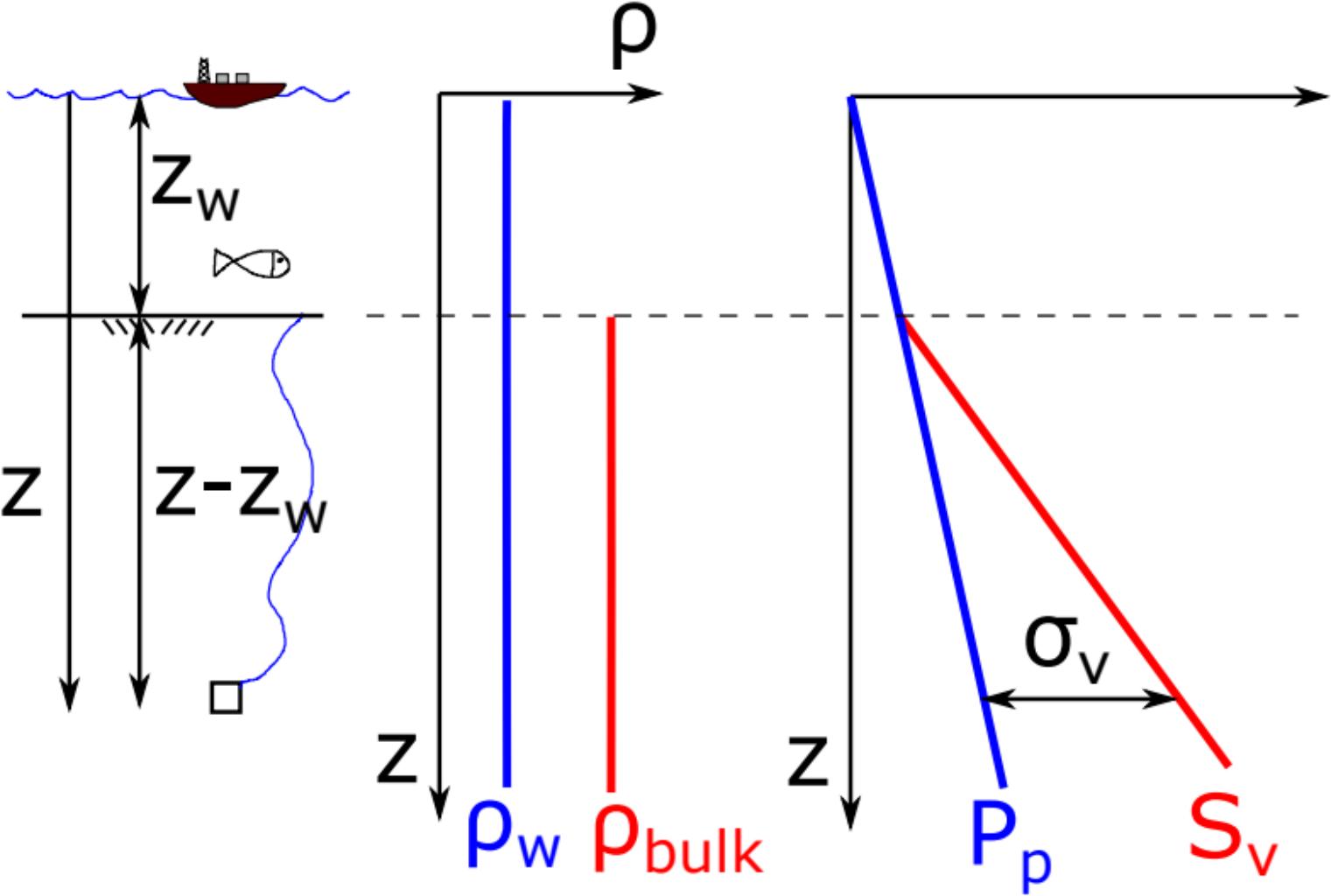




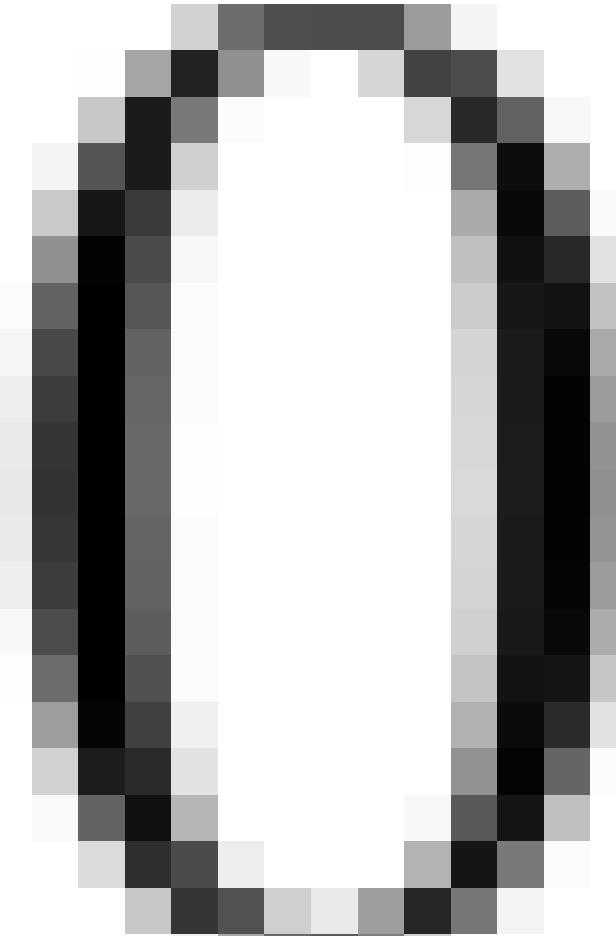
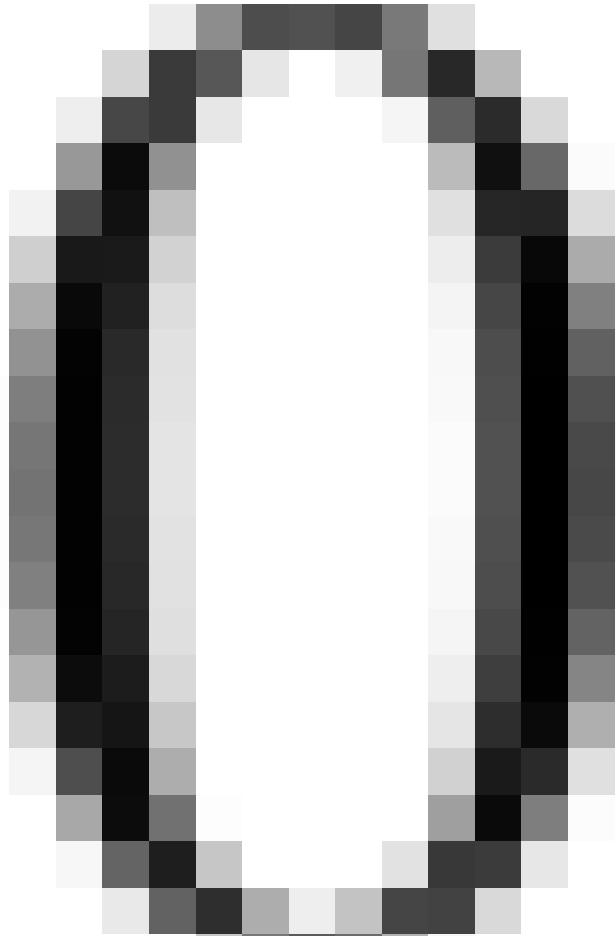
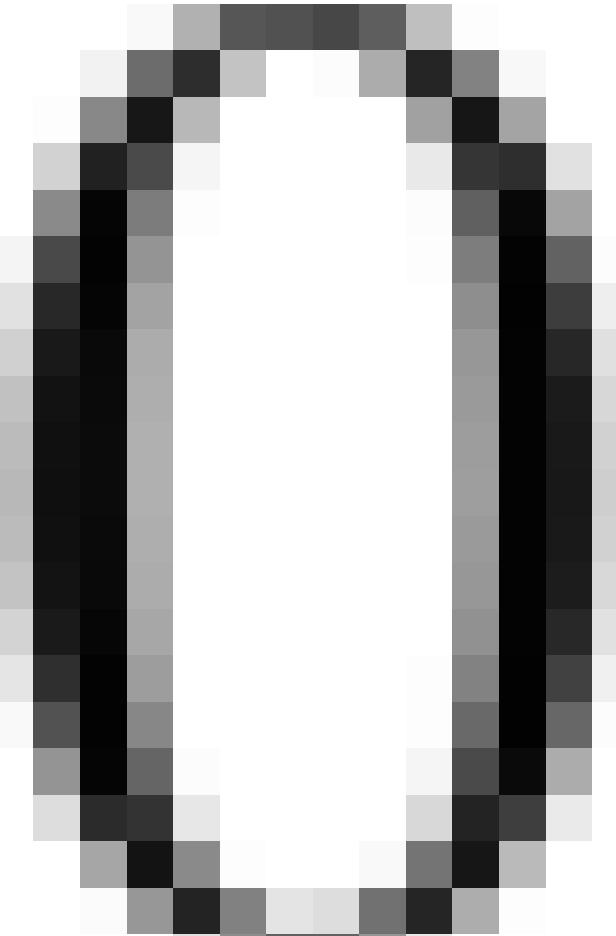
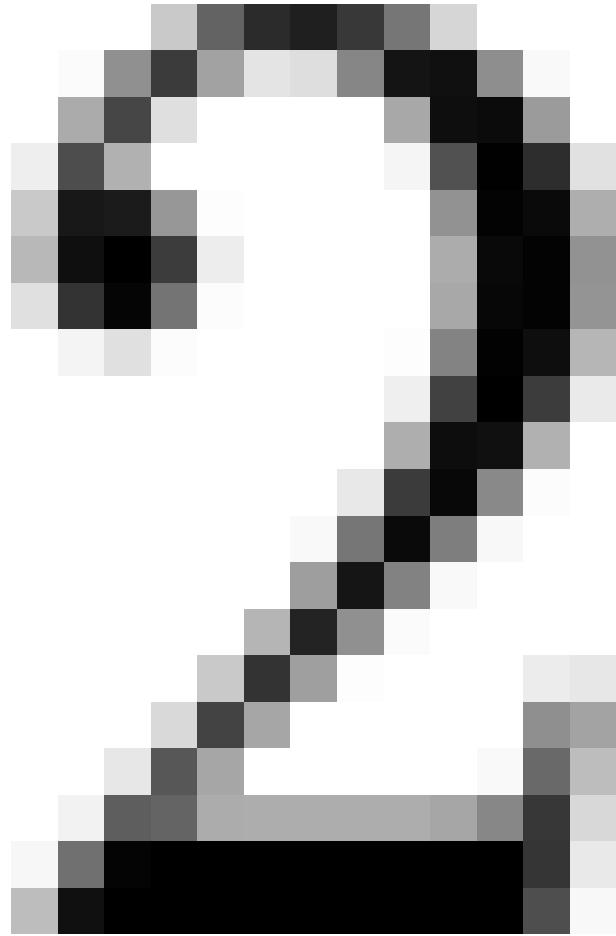


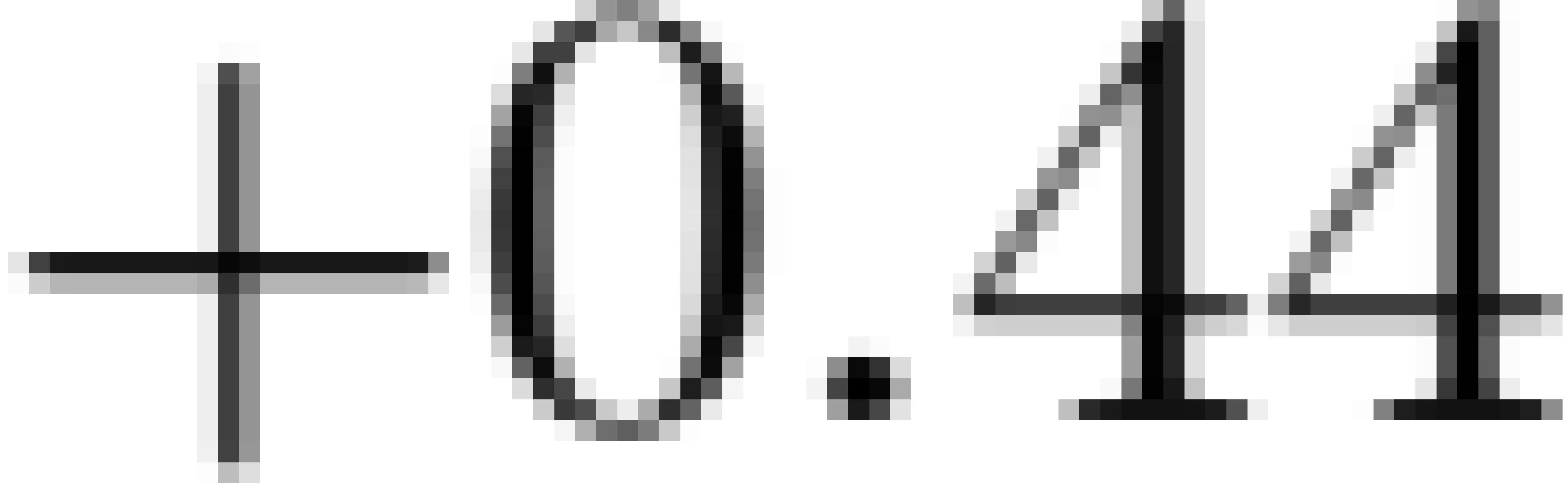


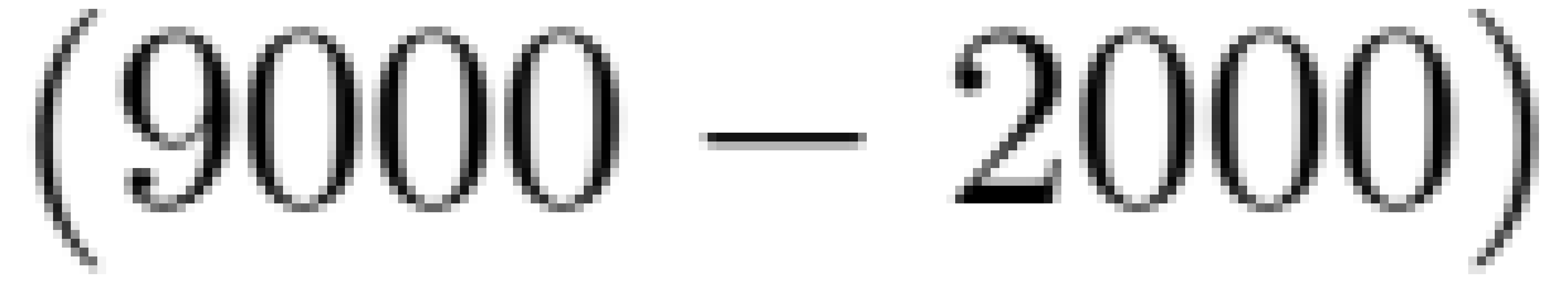


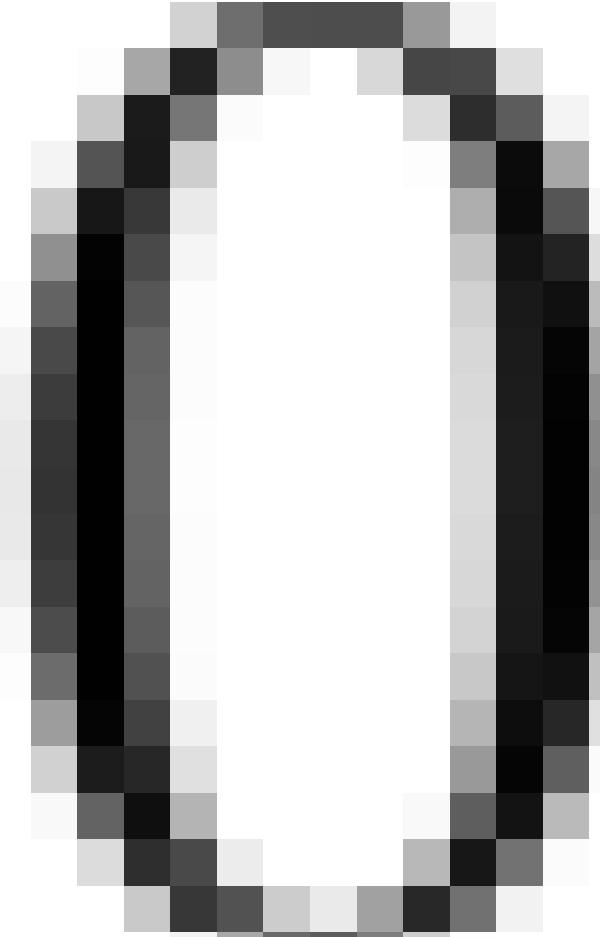
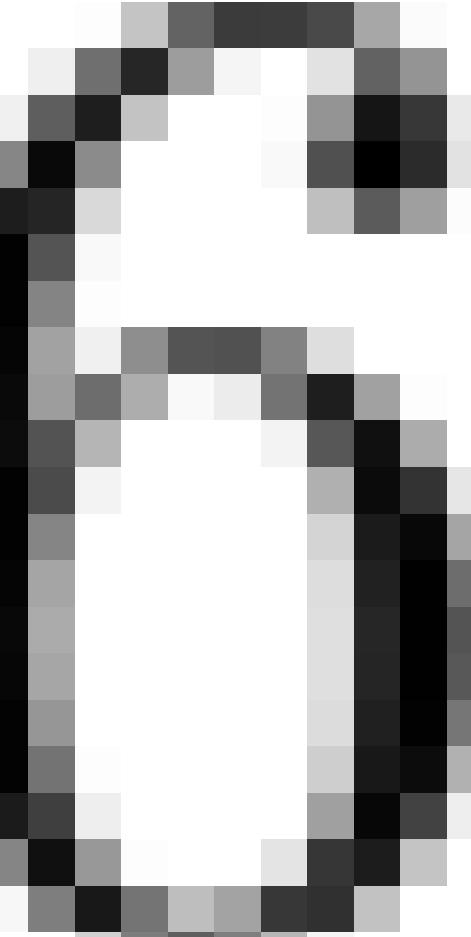
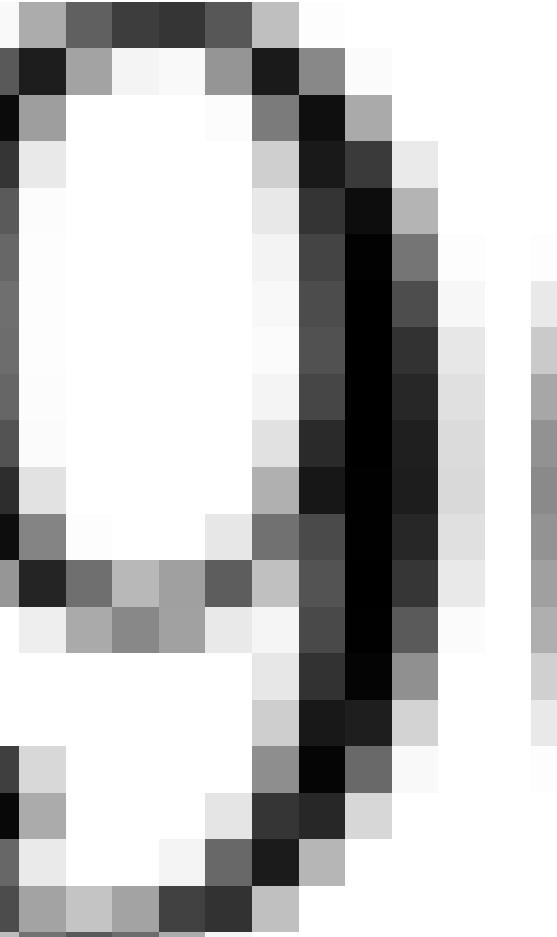
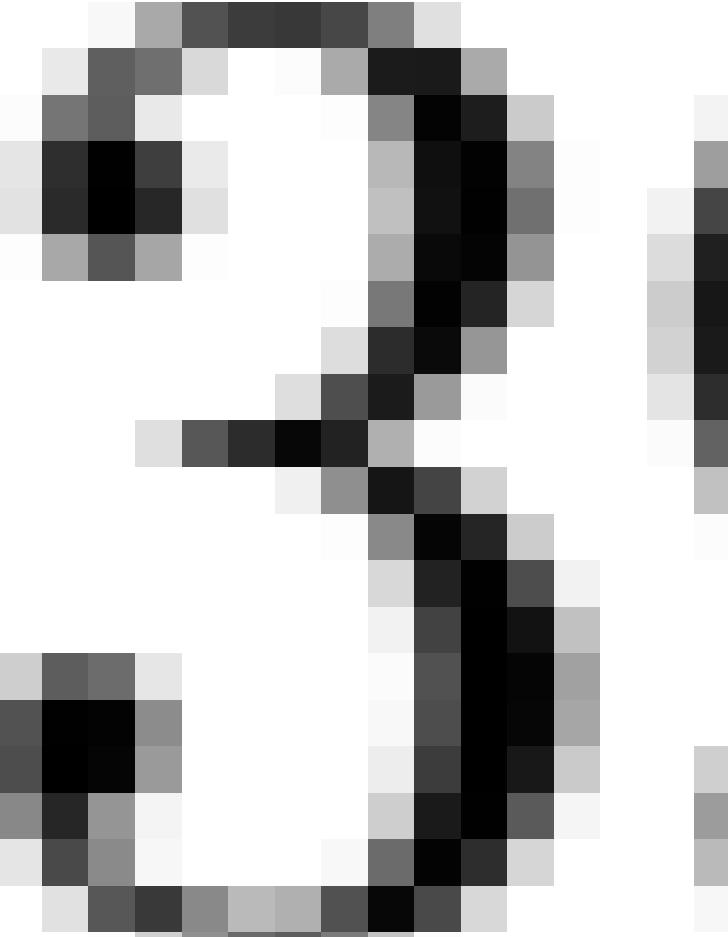


$$P_p = \rho w g z_w + \frac{dP}{dz} (z - z_w) = 0.44$$

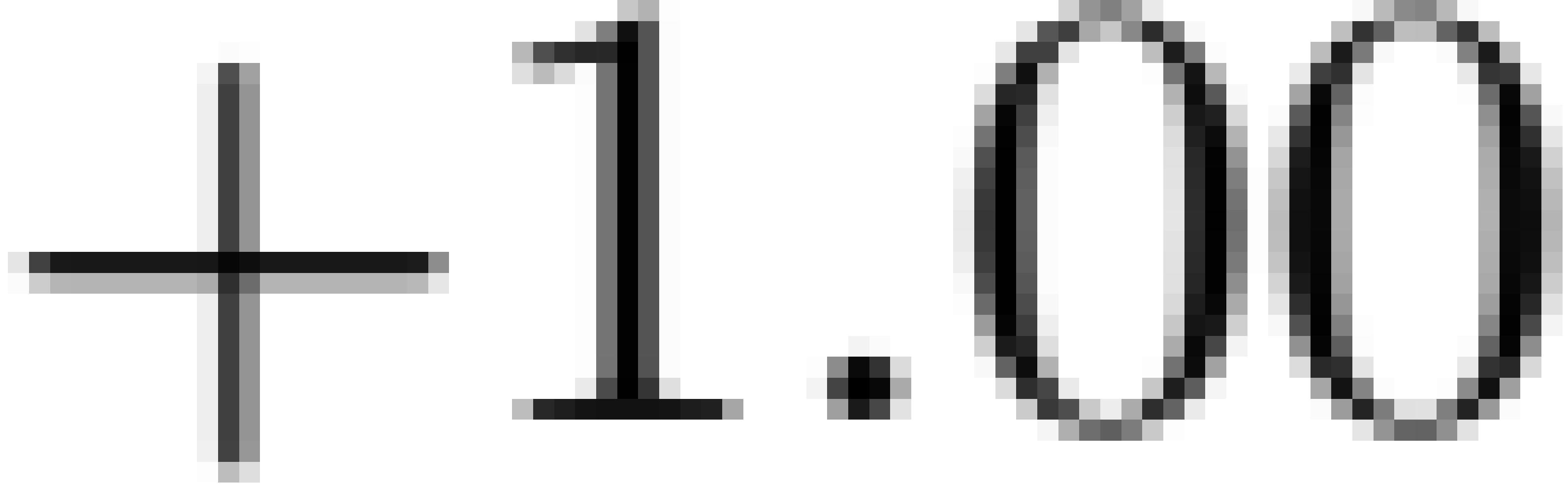


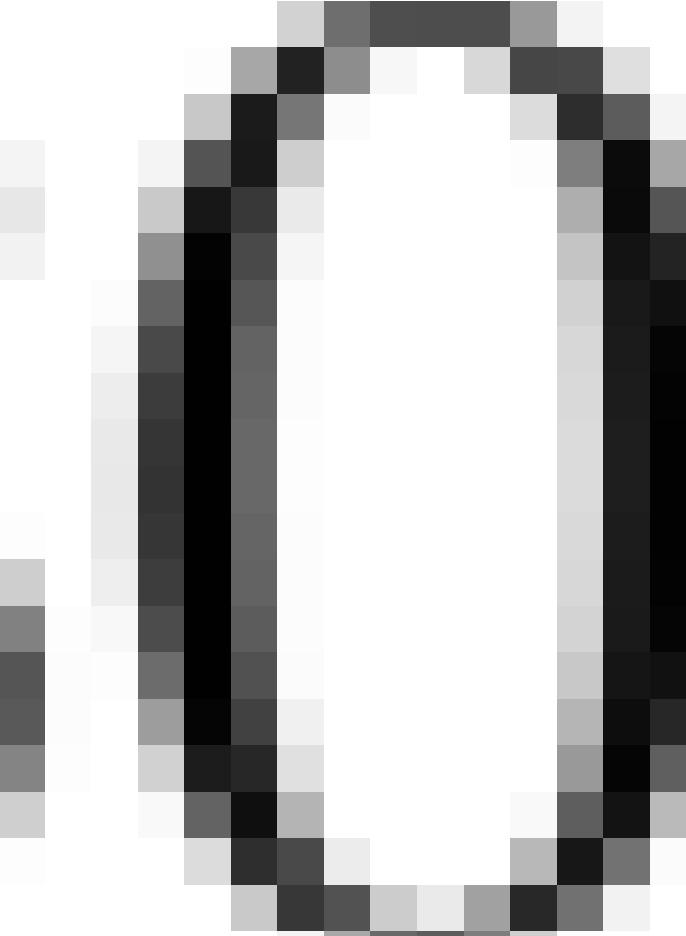
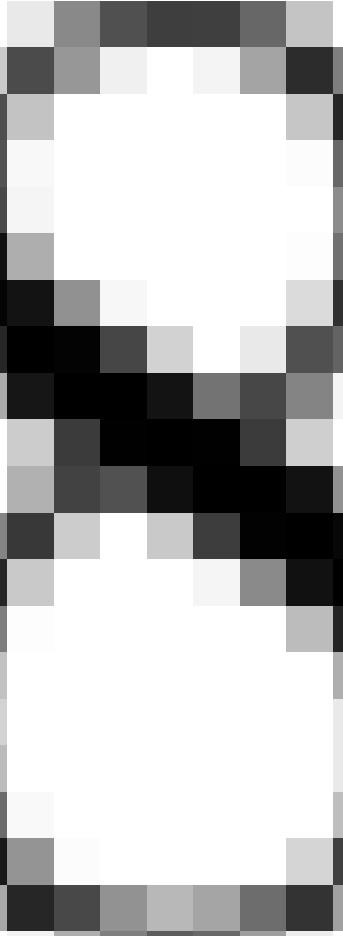
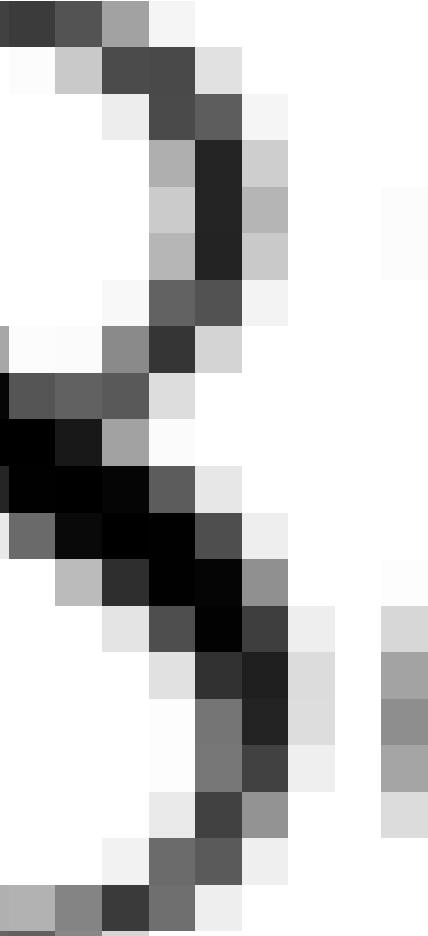
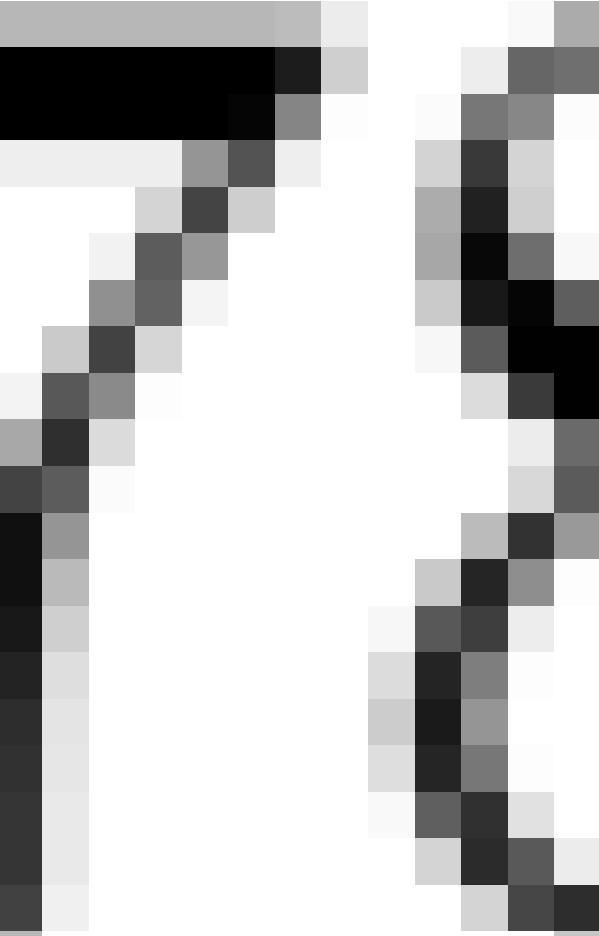


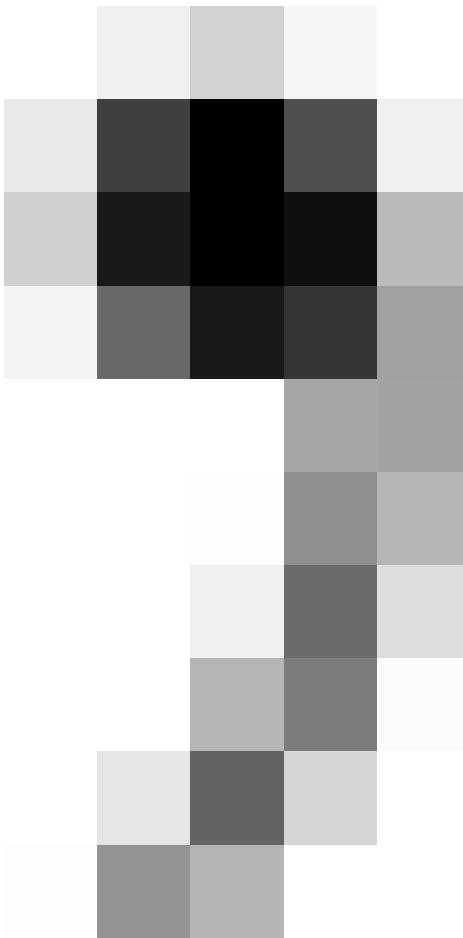


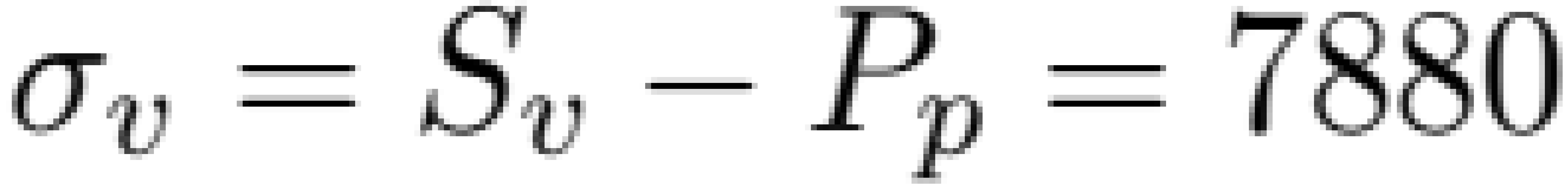


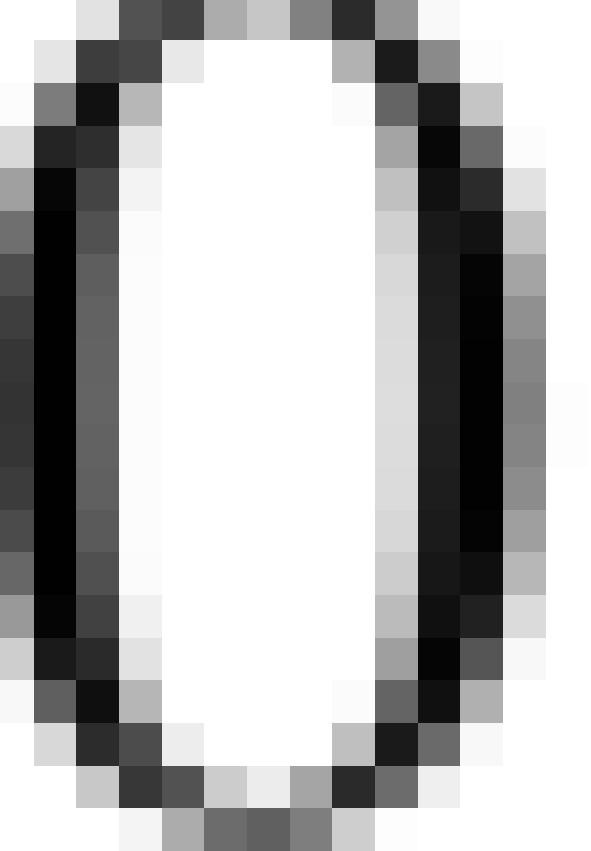
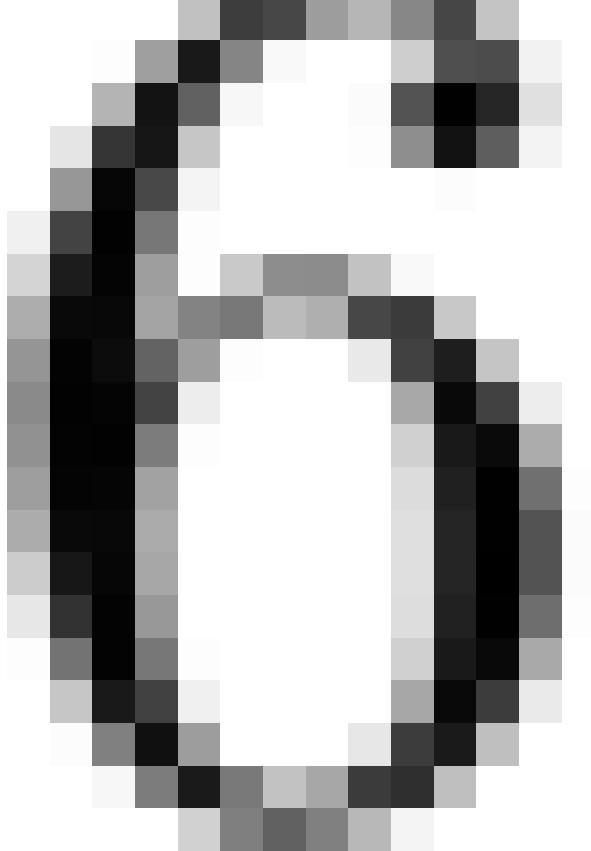
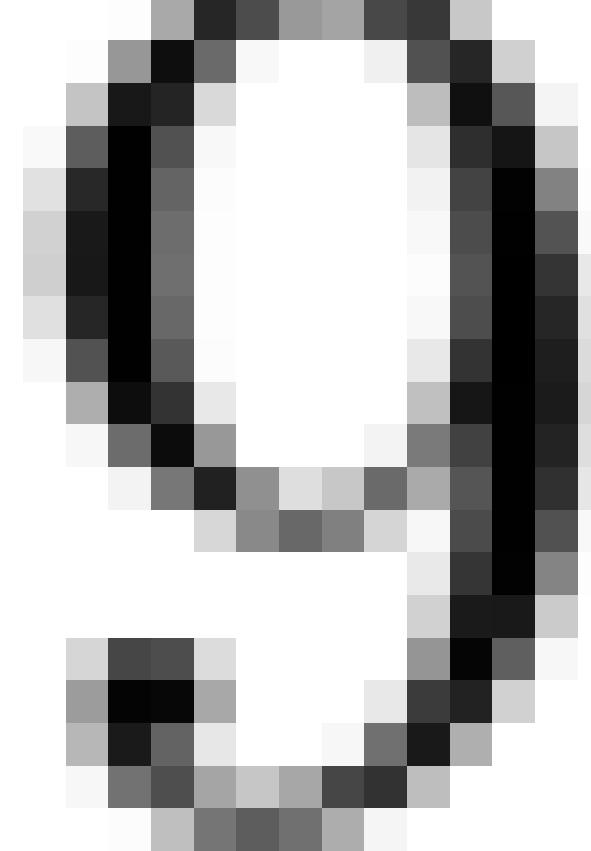
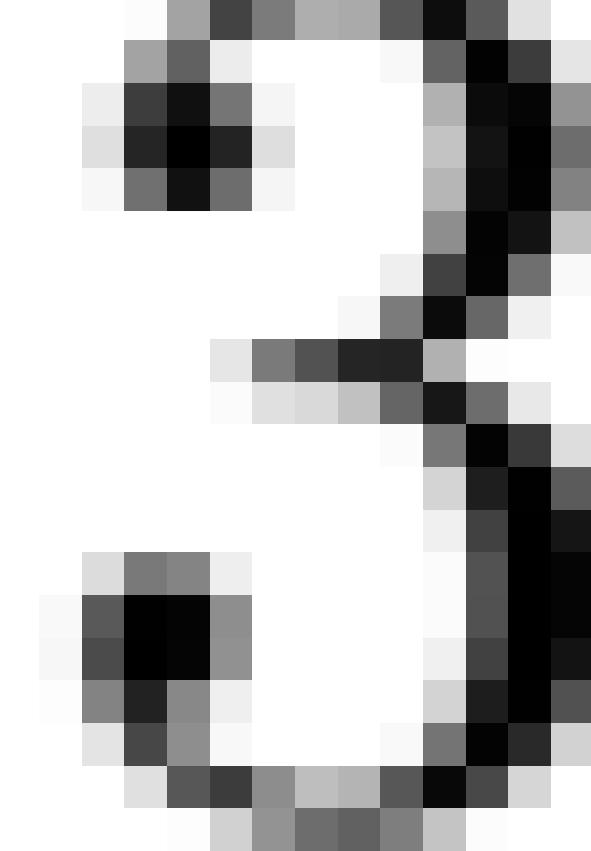
$$S_u = \rho_{u,g} z_u + \frac{dS_u}{dz} (z - z_u) = 0.44$$

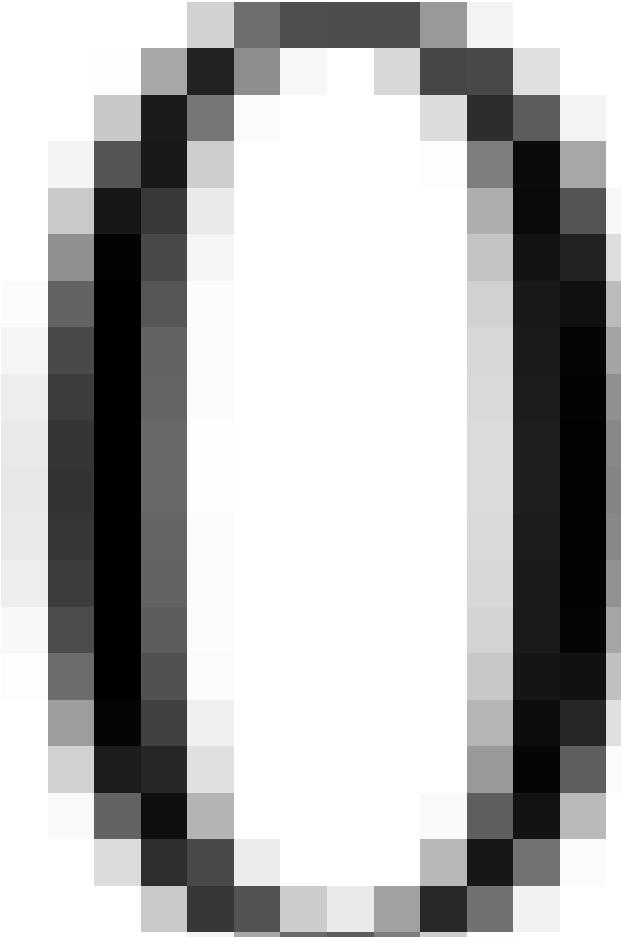
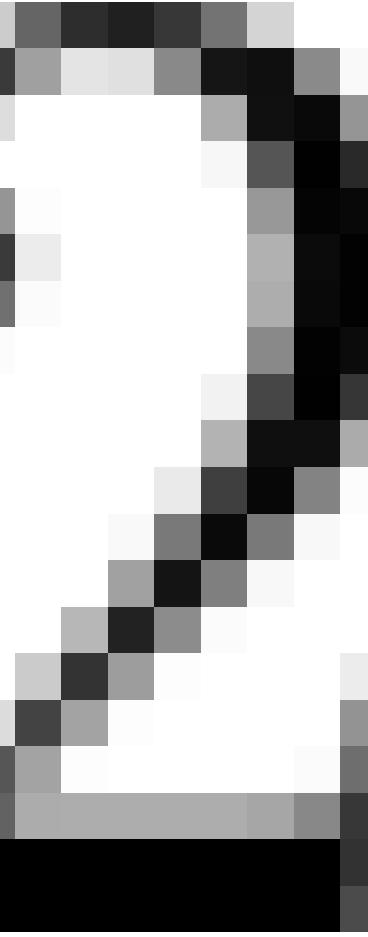
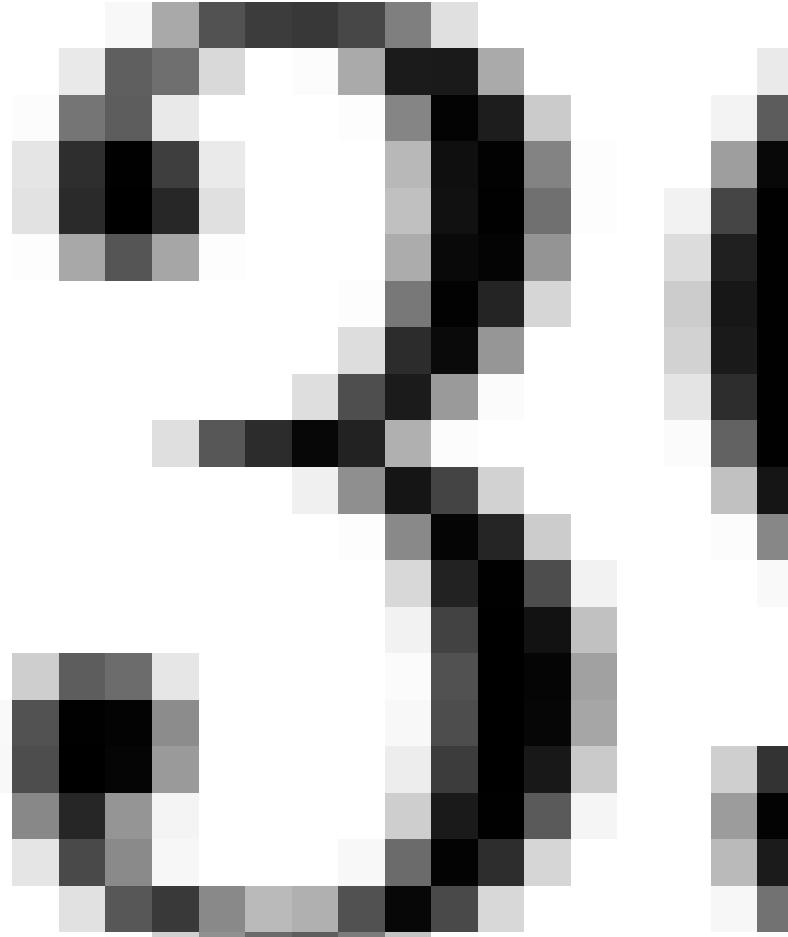


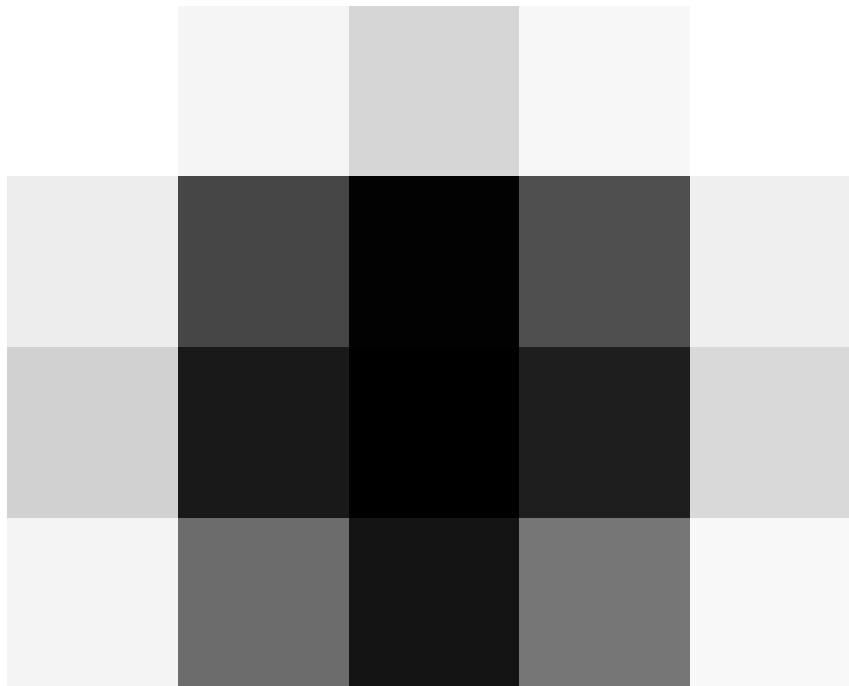


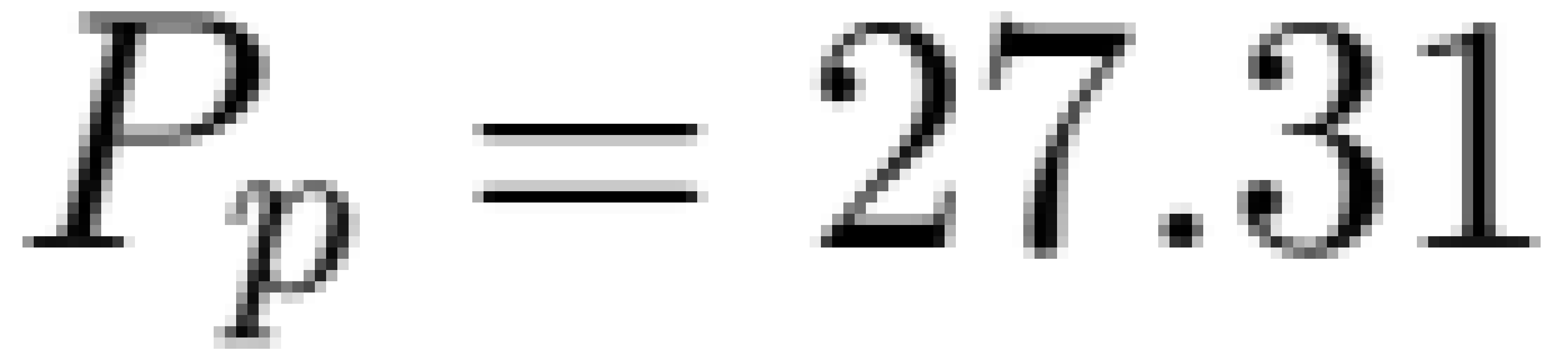






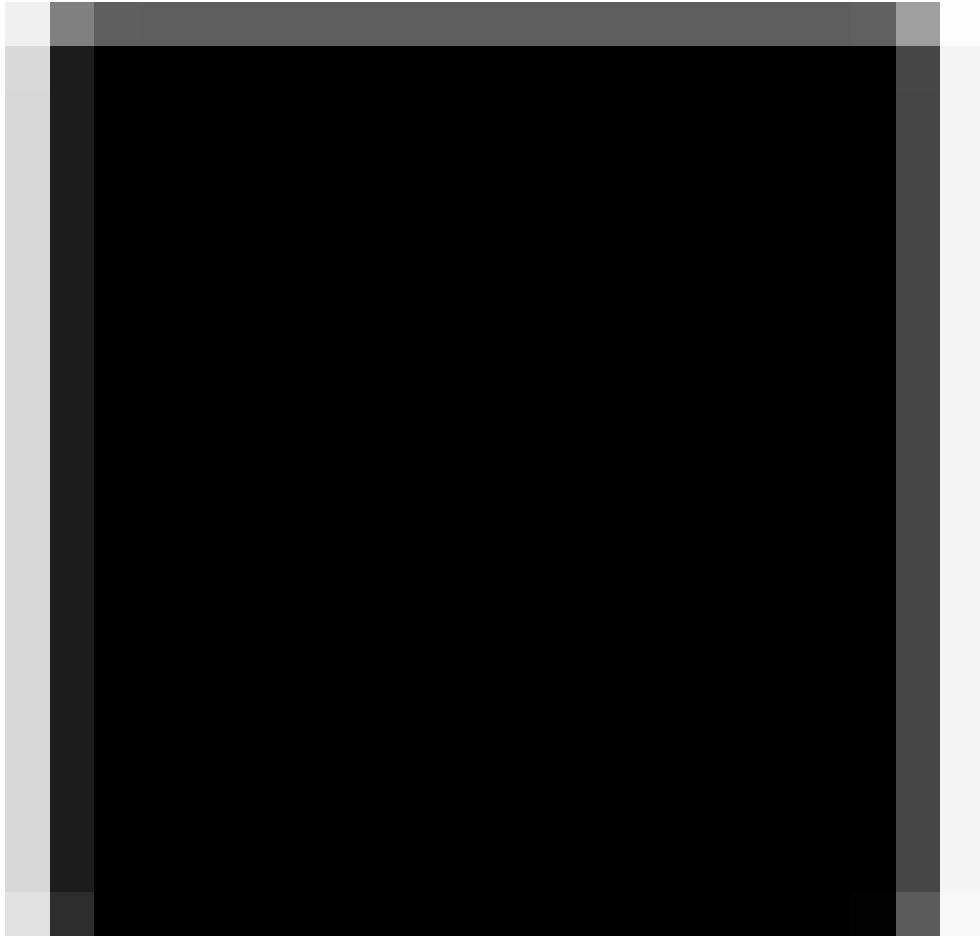








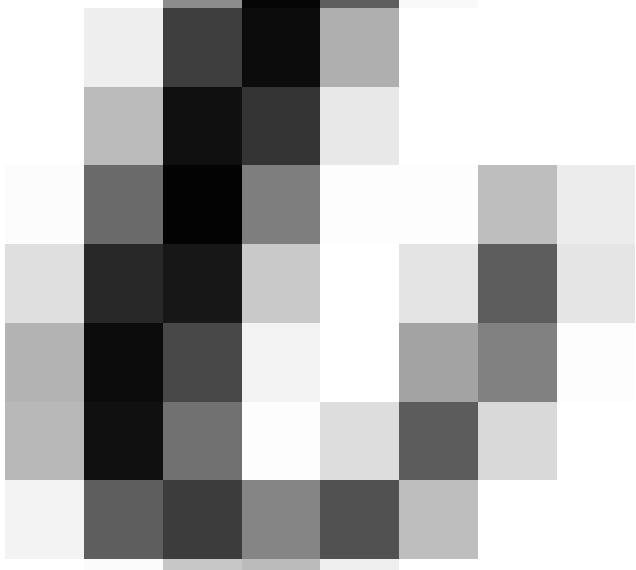
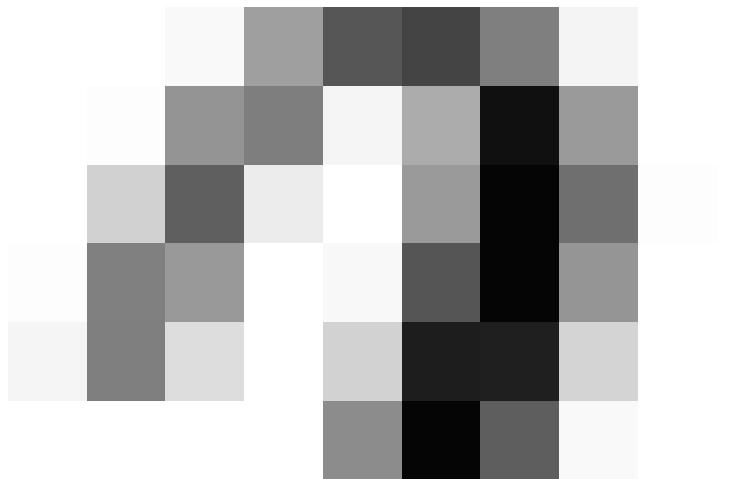
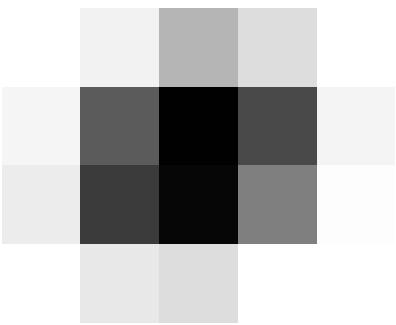


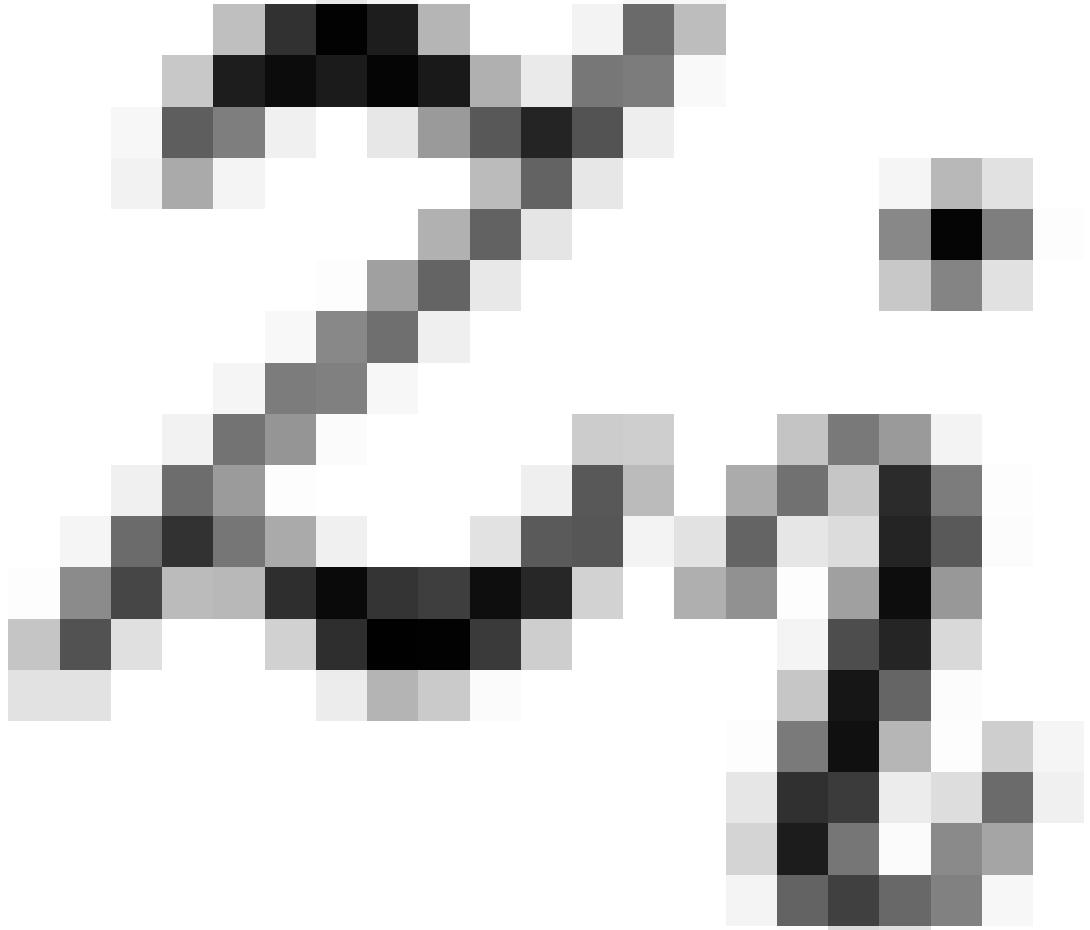


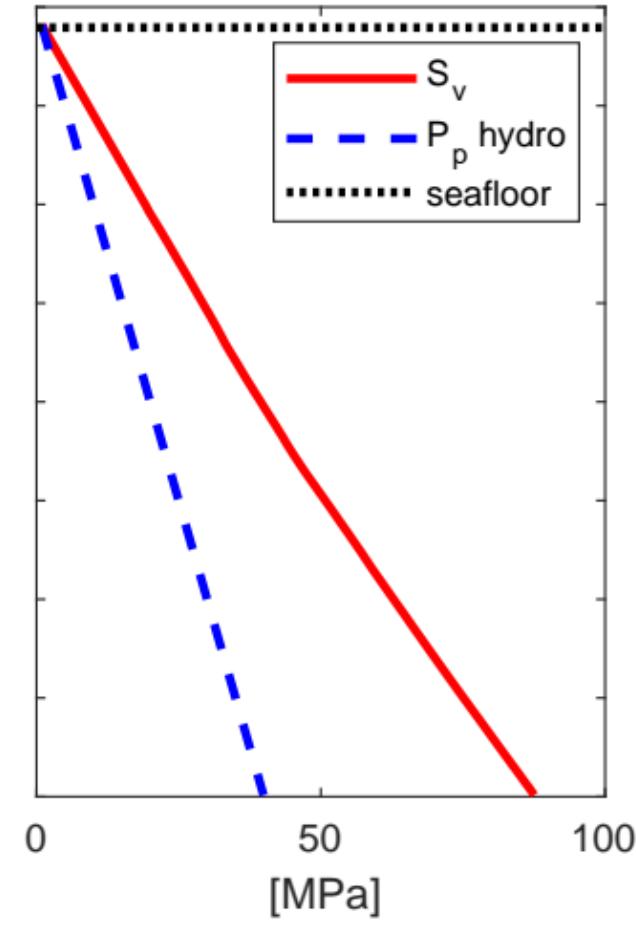
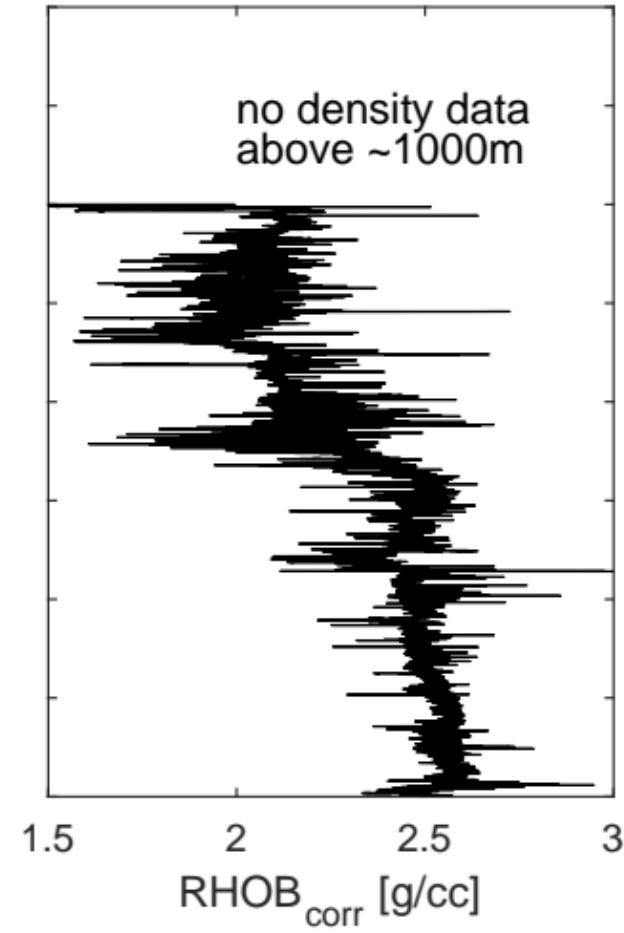
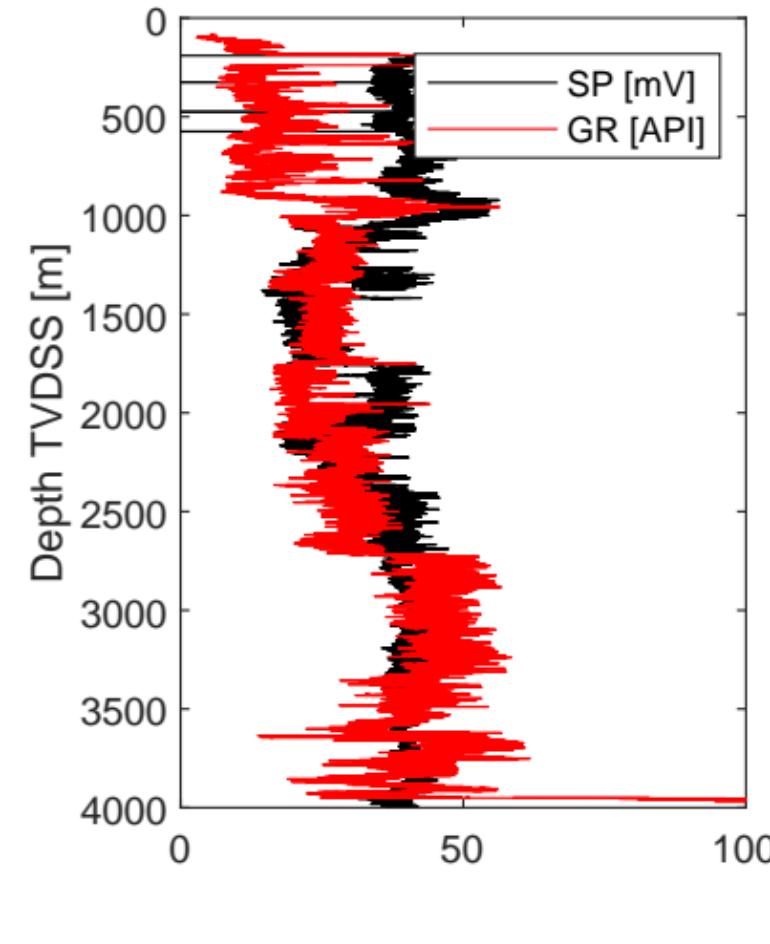
$$S_U(z) = \int_0^z \rho_{bulk}(z') dz'$$

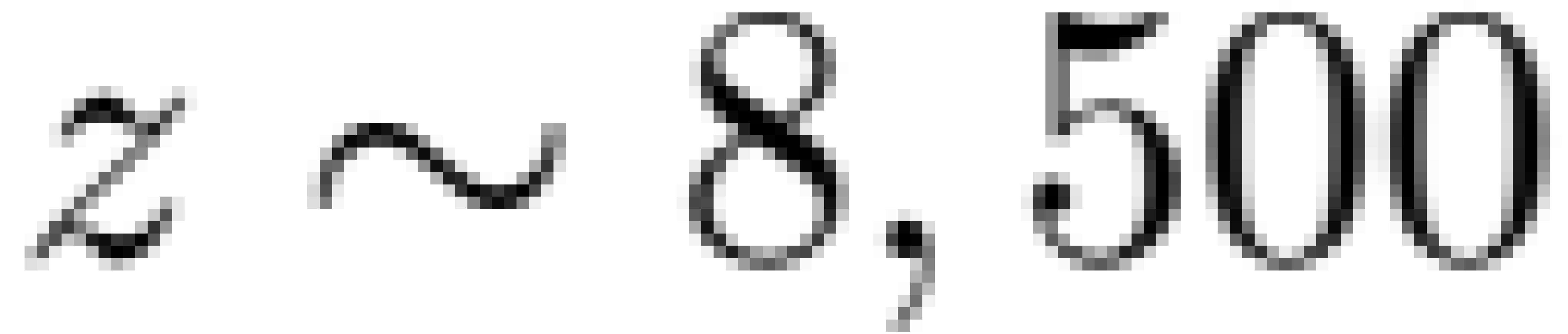


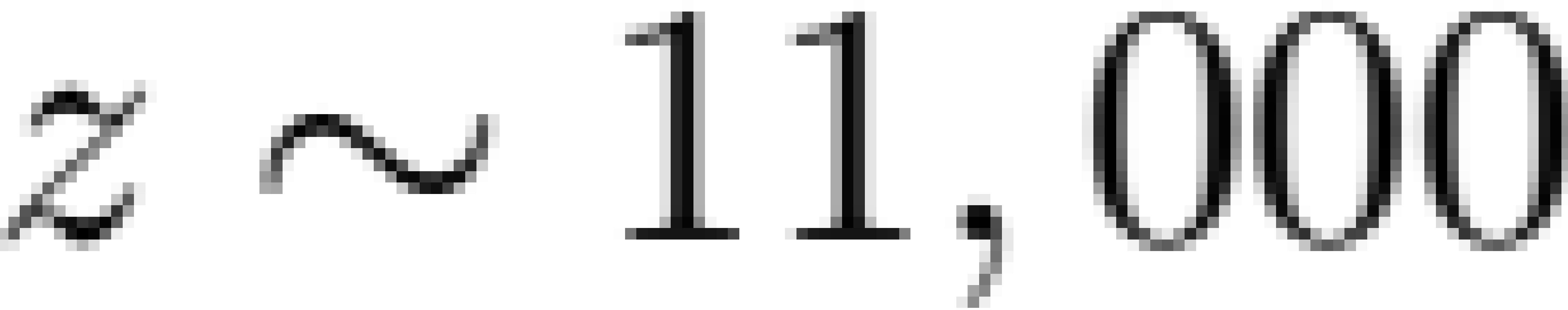
$$S_v(z_i) = \sum_{j=1}^i \rho_{bulk}(z_i) g\Delta z_i$$



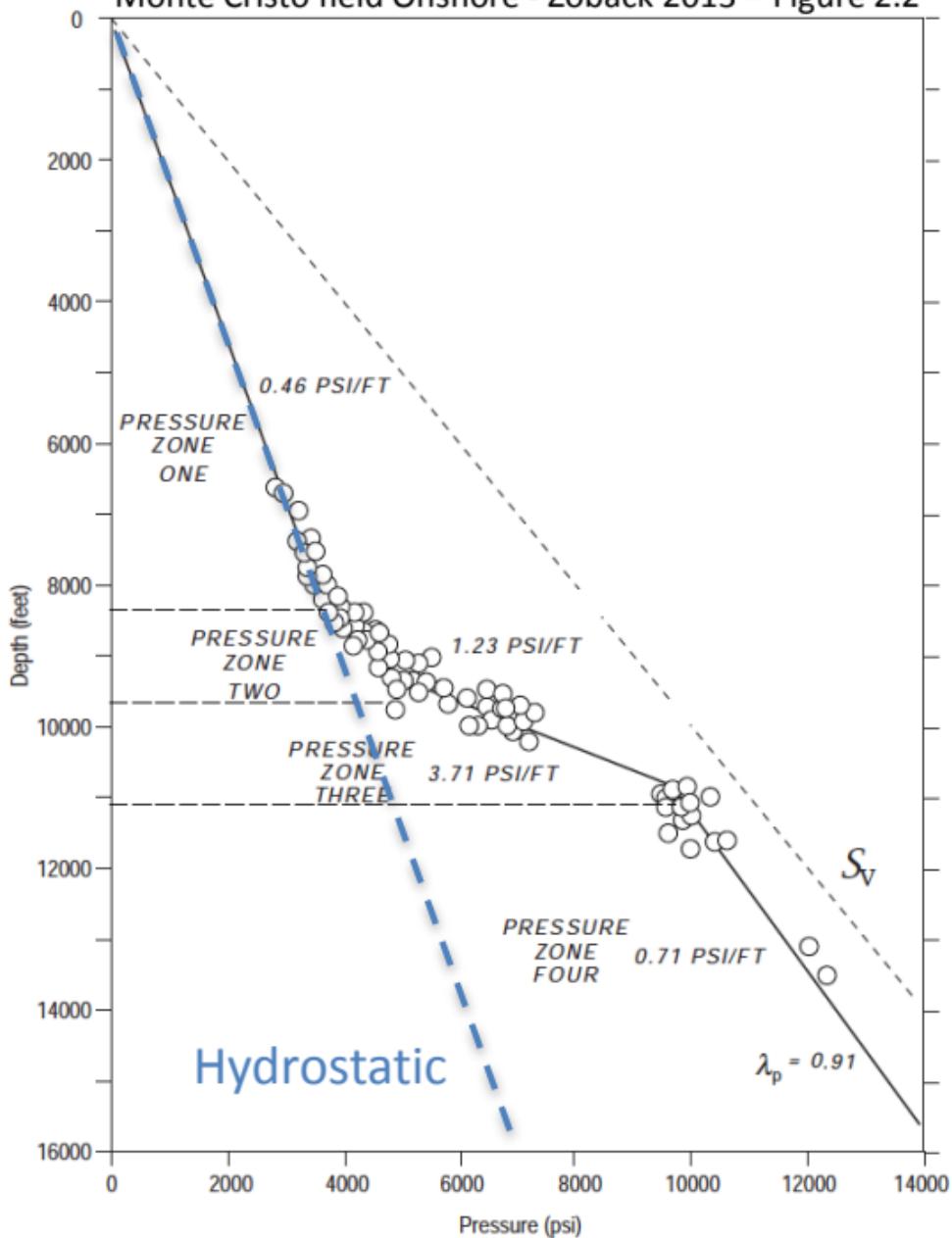








Monte Cristo field Onshore - Zoback 2013 – Figure 2.2



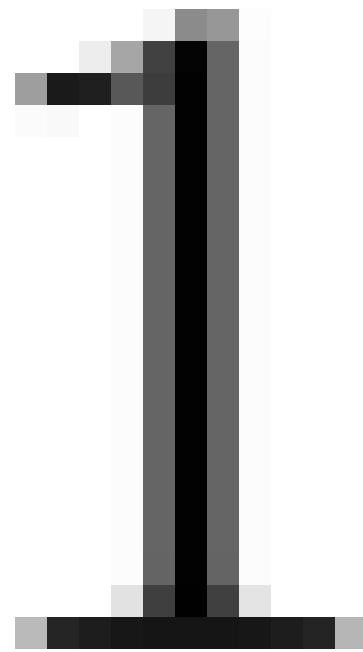
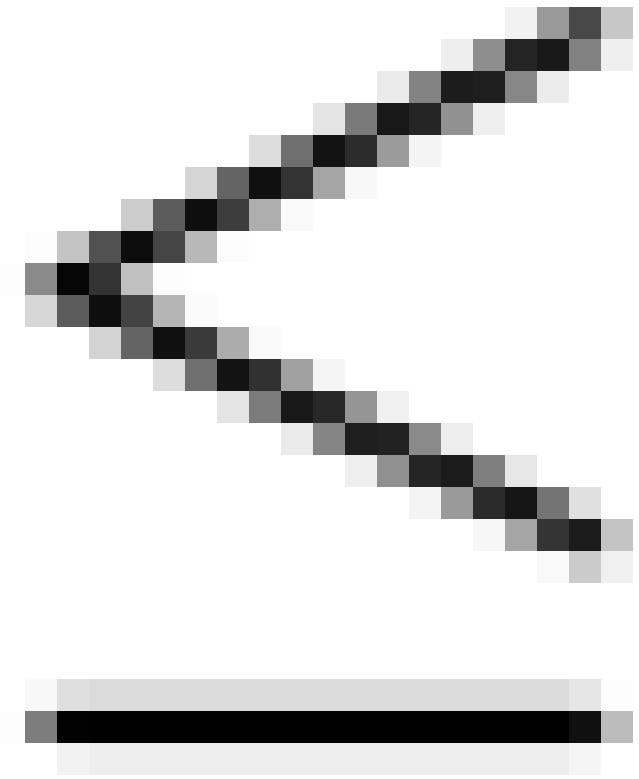


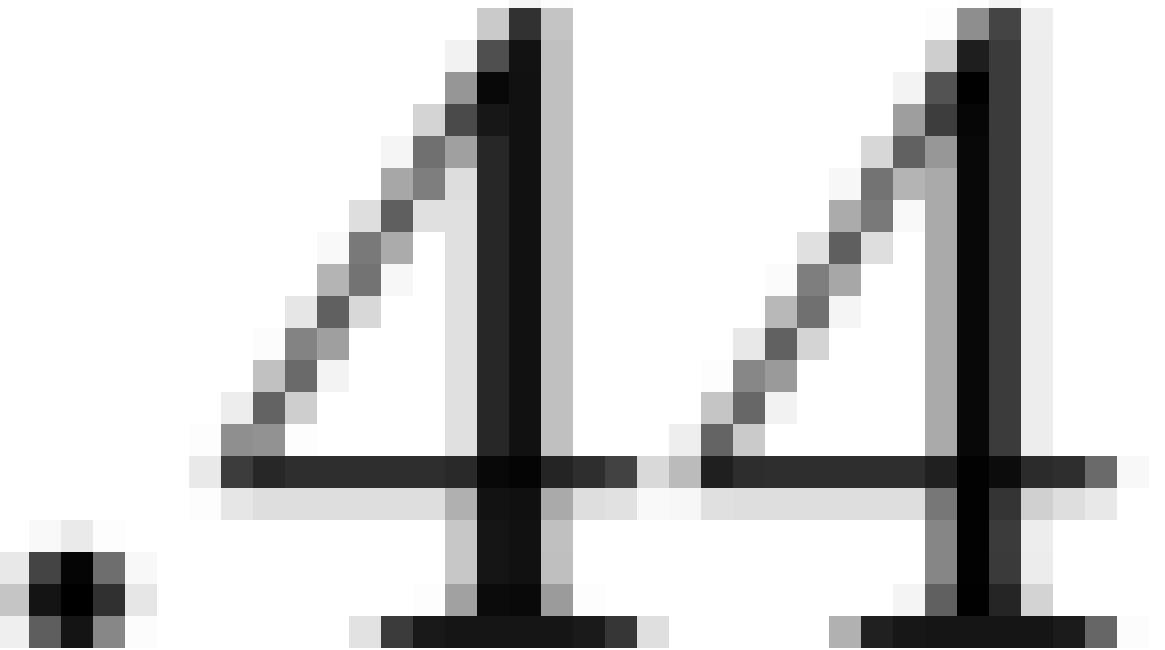
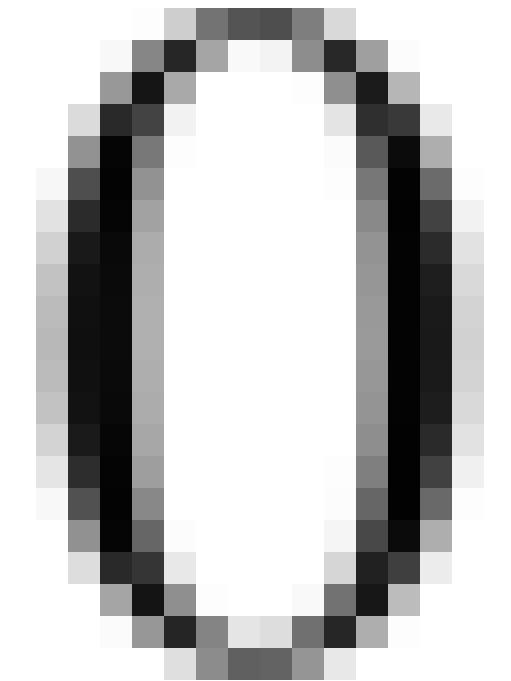
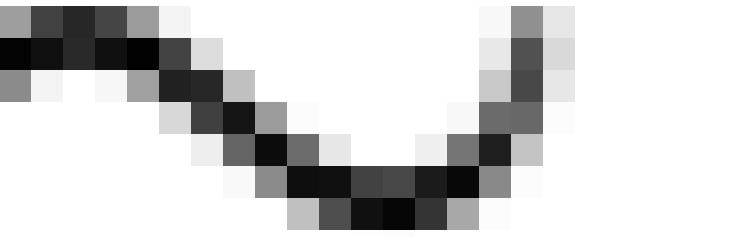
$\lambda_p(z)$

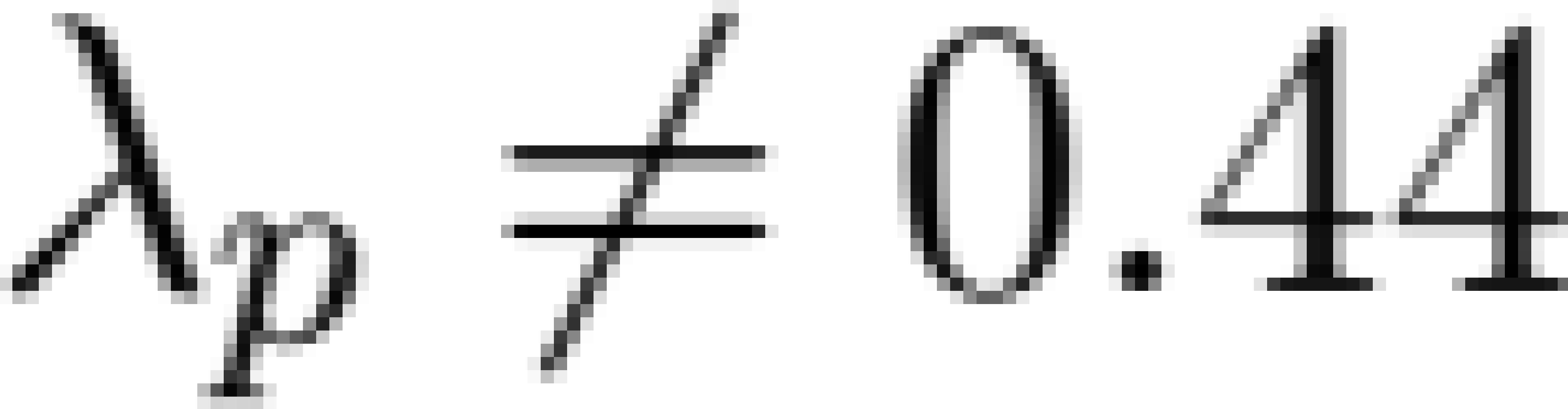


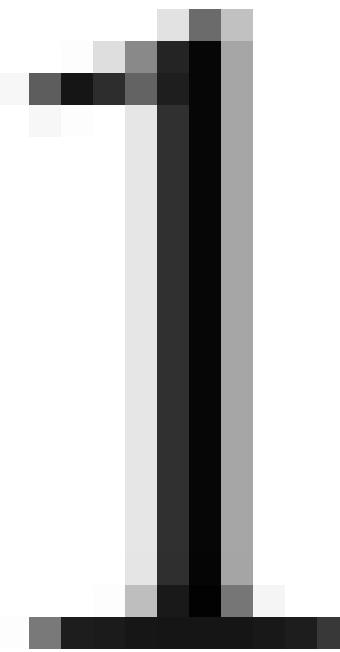
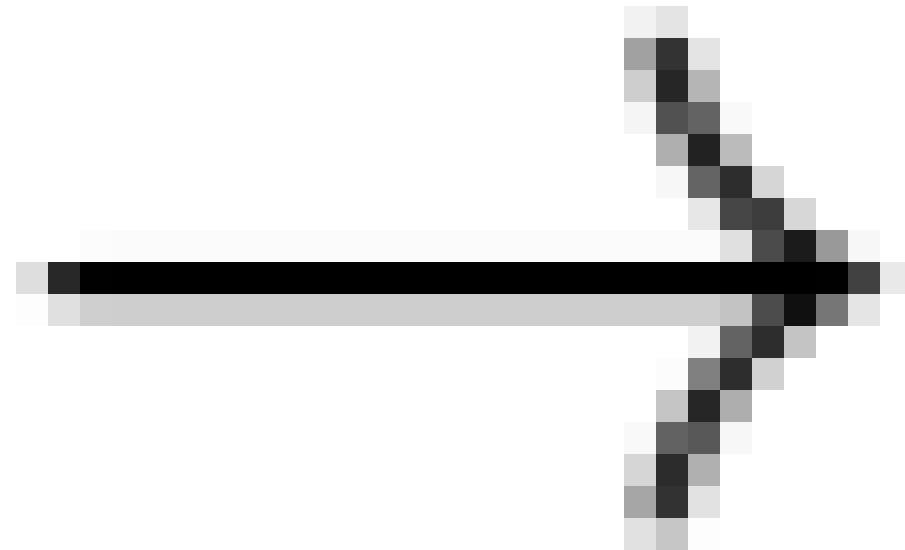
$P(z)$
 $S_T(z)$

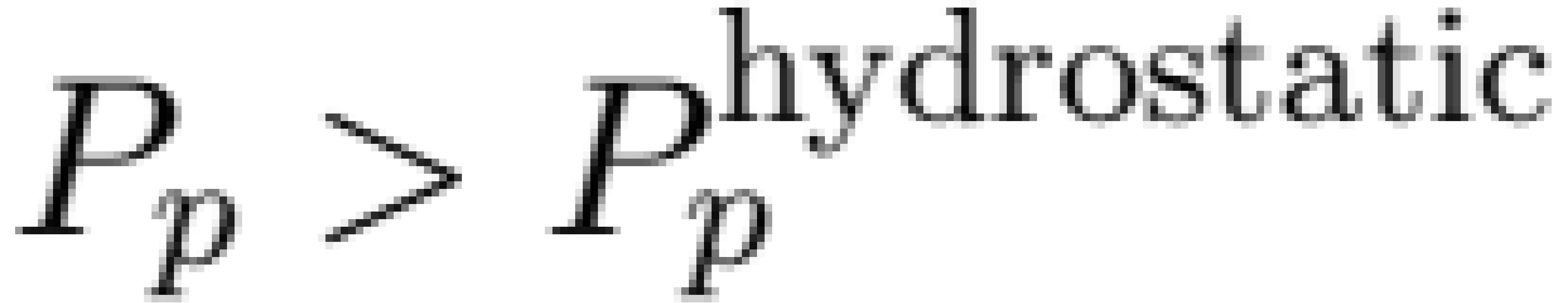




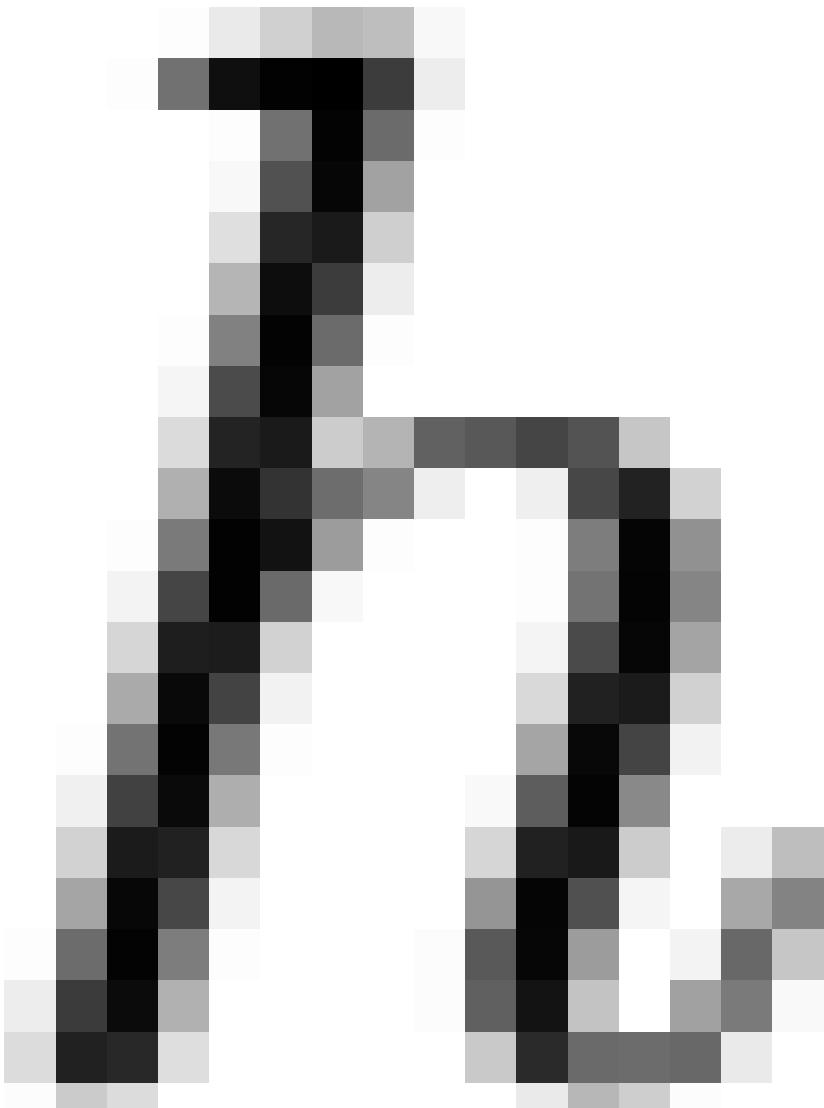














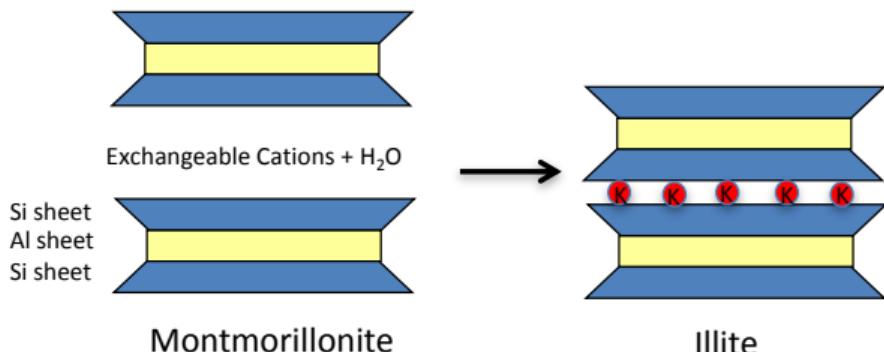


- **Aquathermal pressurization**

- $\Delta T \rightarrow \Delta P$

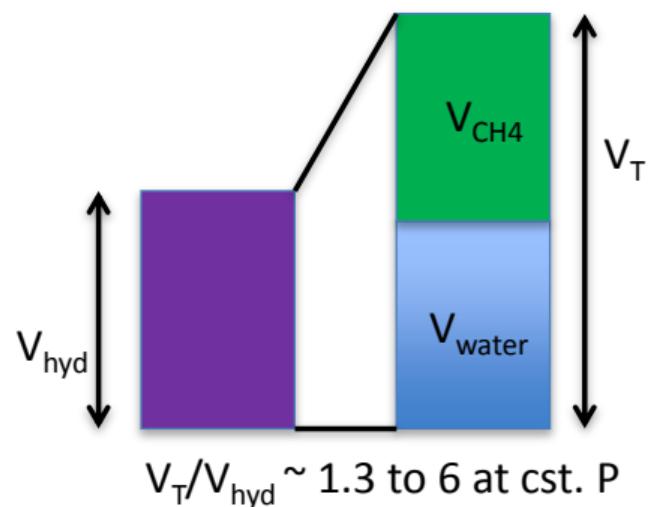
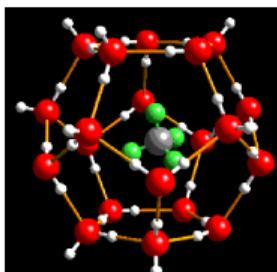
- **Dehydration reactions**

- $\Delta V \rightarrow \Delta P$
 - Montmorillonite to Illite (frees water)

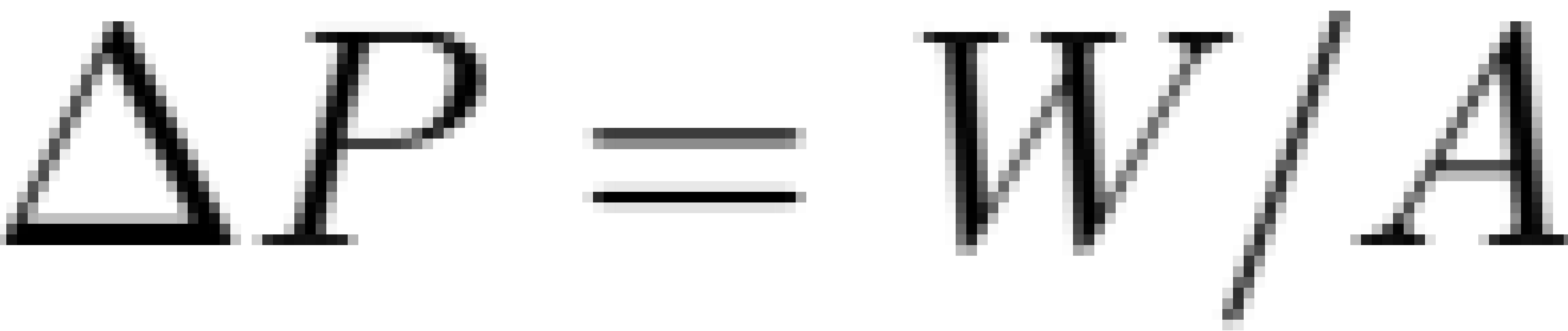


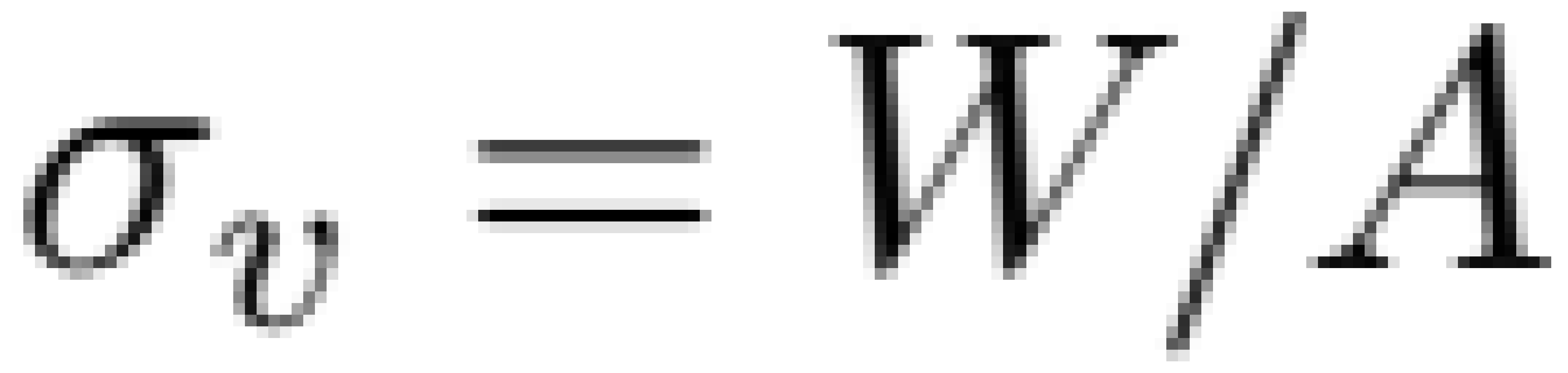
- **Hydrocarbon generation**

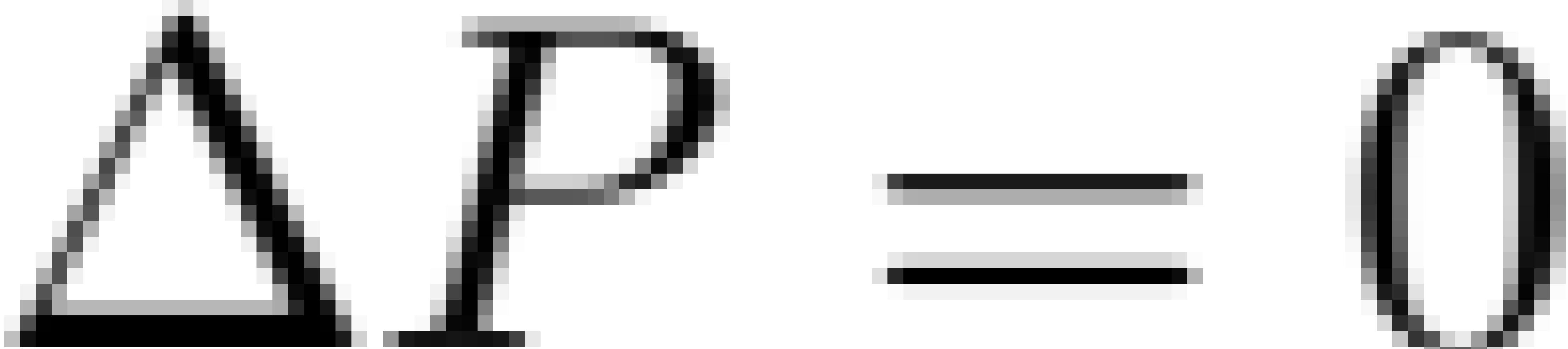
- $\Delta V \rightarrow \Delta P$



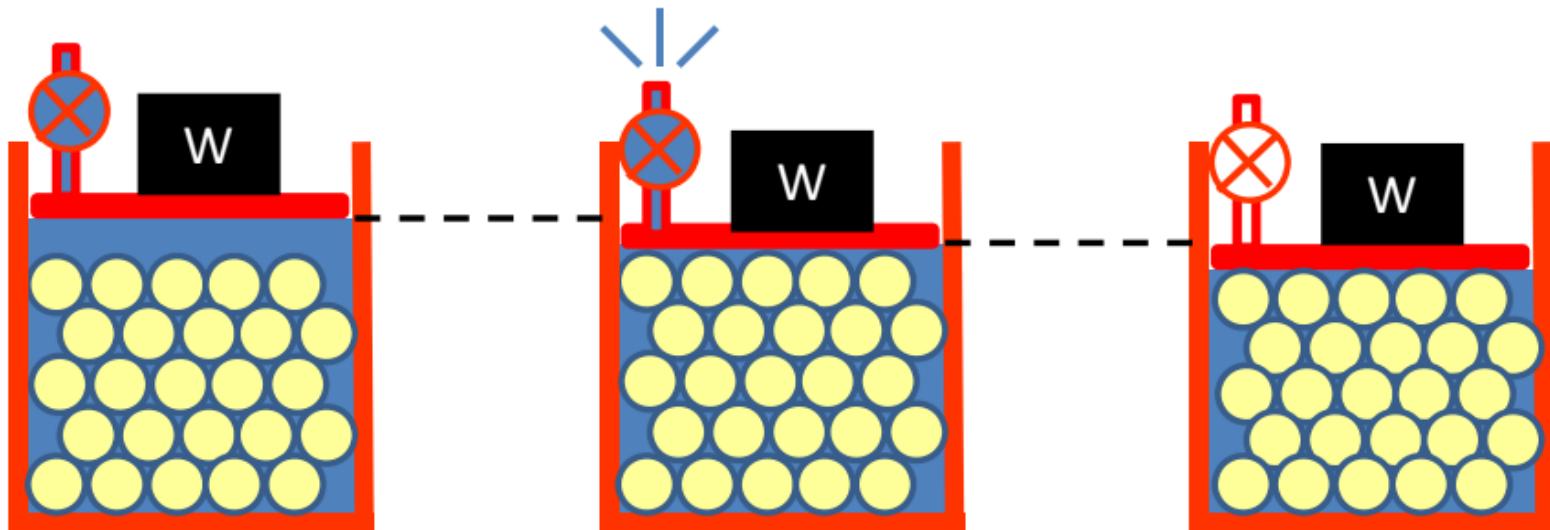




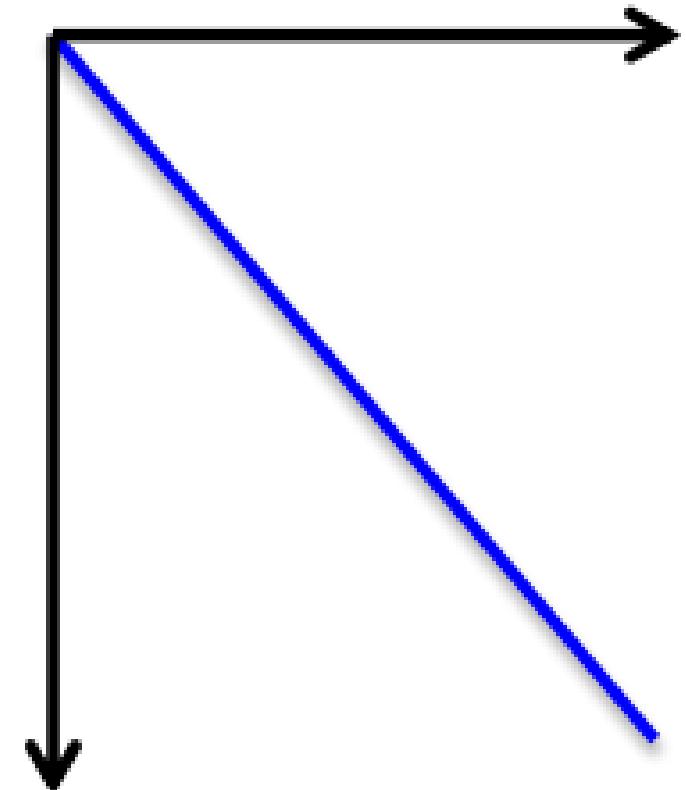
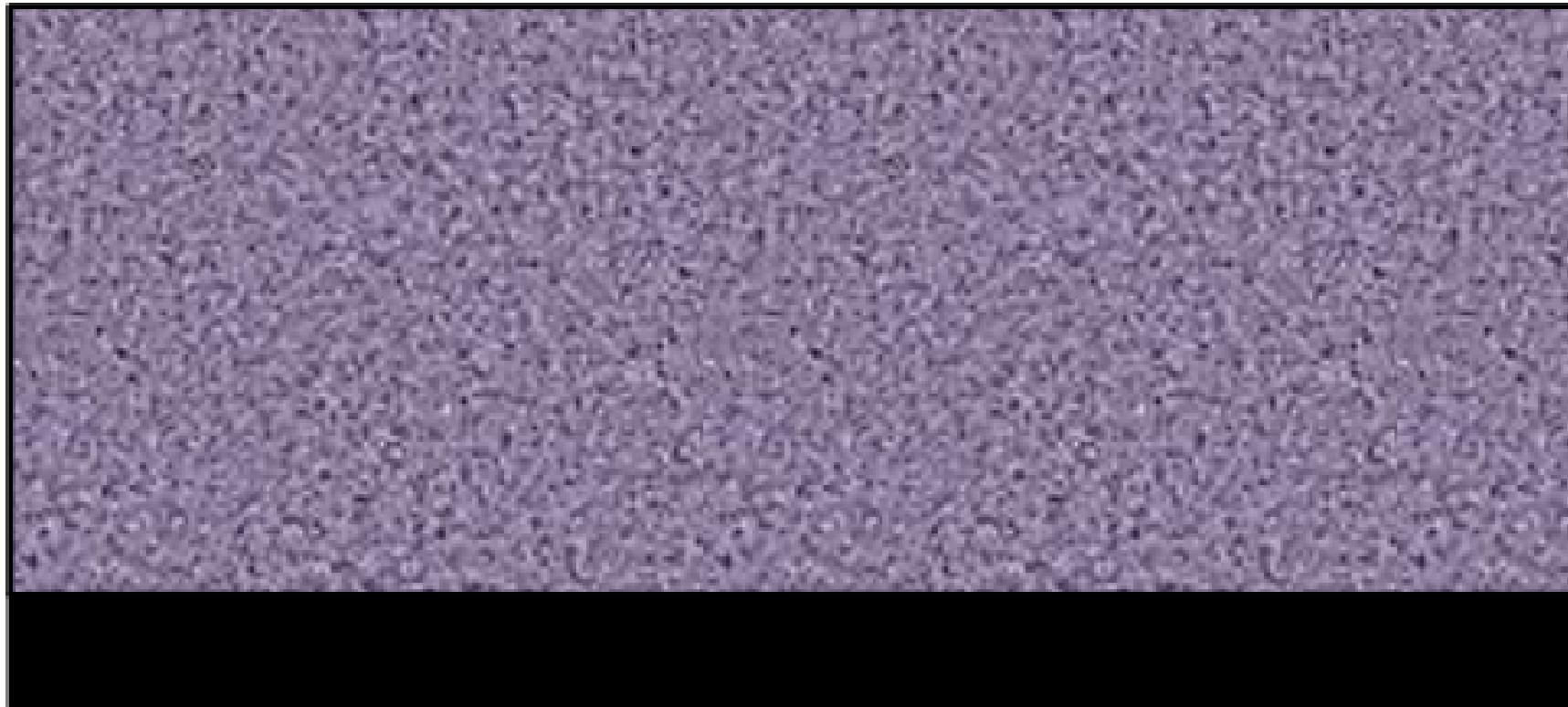


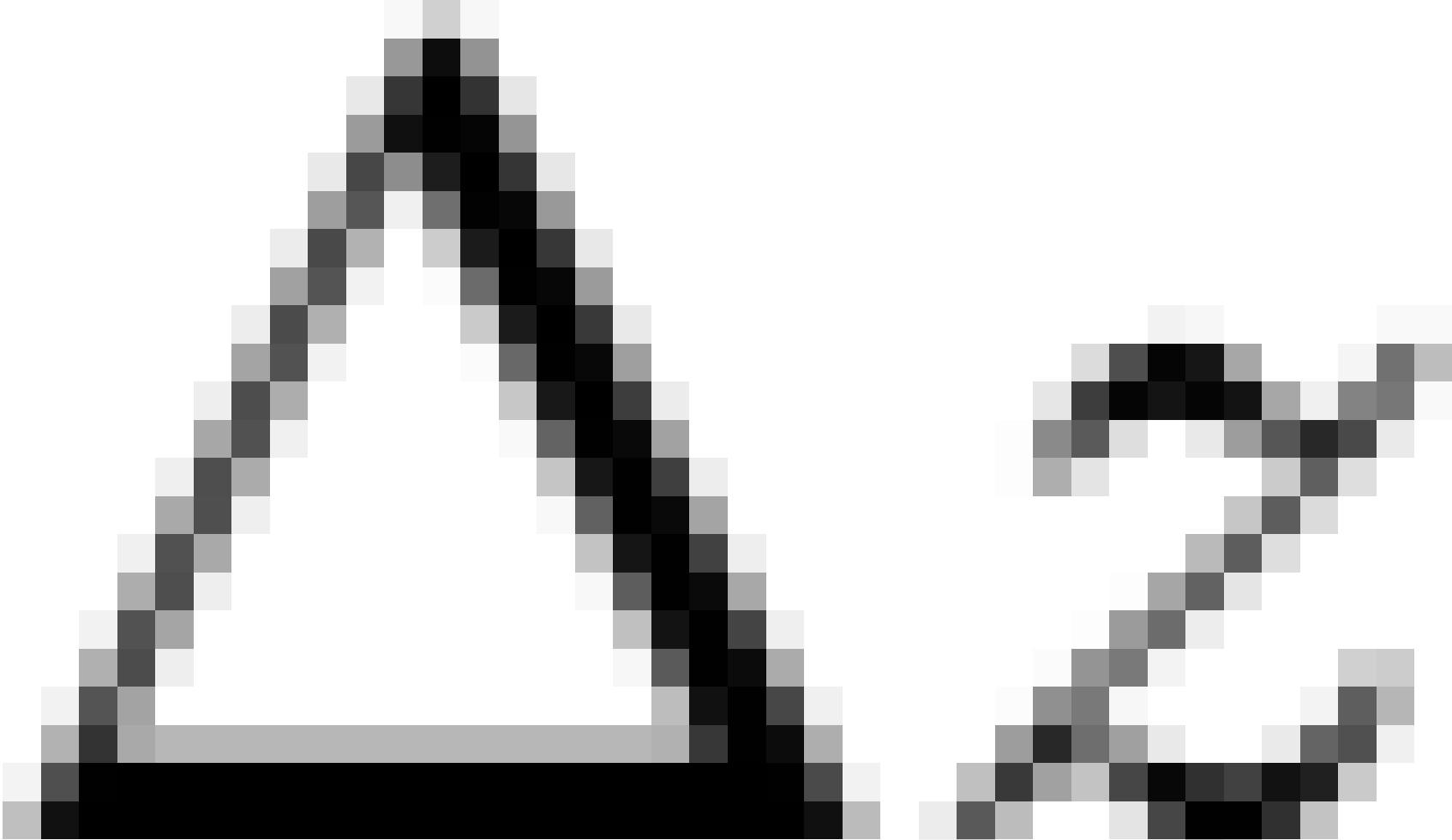


- **Disequilibrium compaction (Underconsolidation)**
 - $\Delta S \rightarrow \Delta P$ (Vertical)
- **Tectonic compression**
 - $\Delta S \rightarrow \Delta P$ (Horizontal)



Pressure water



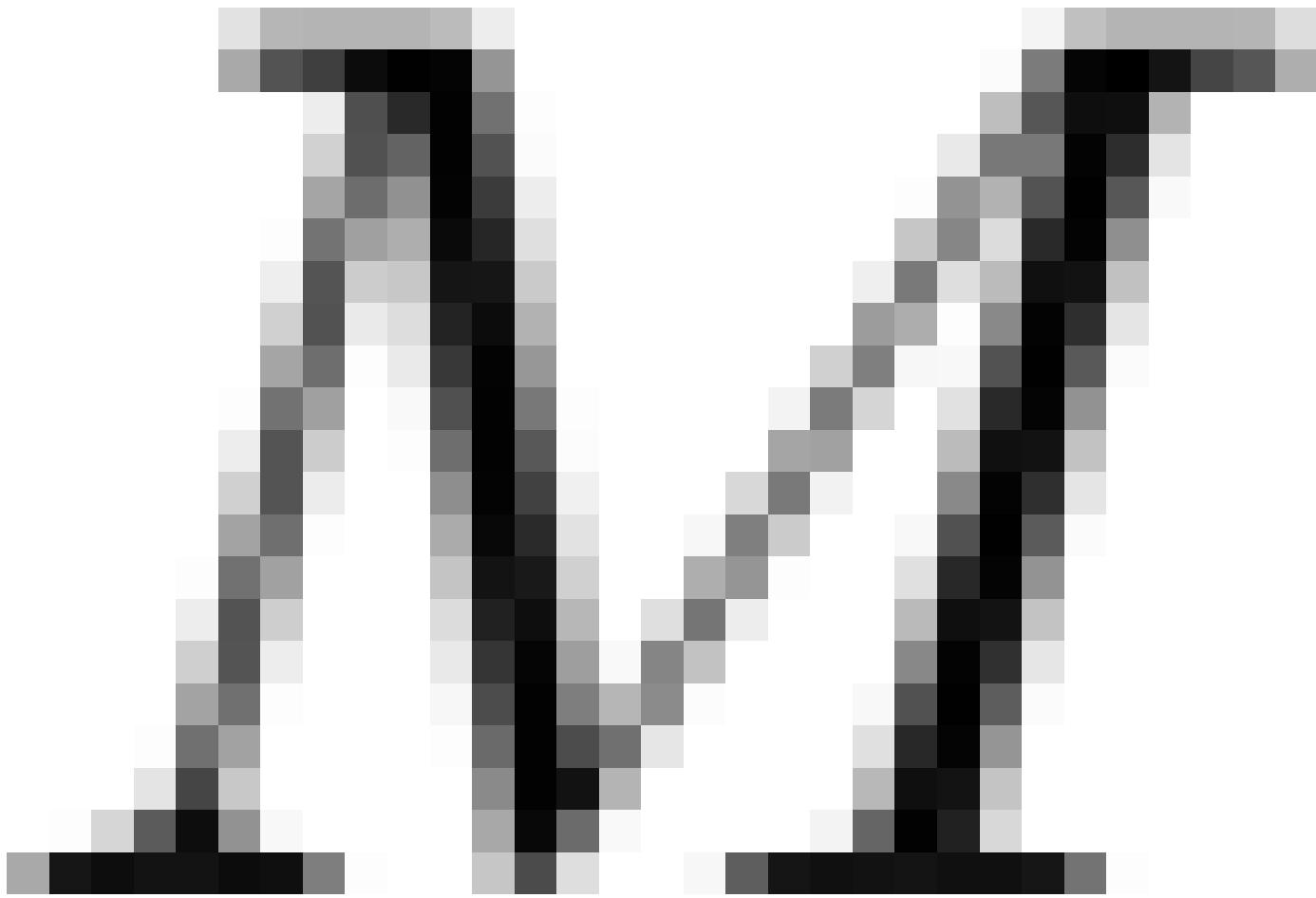


Dh

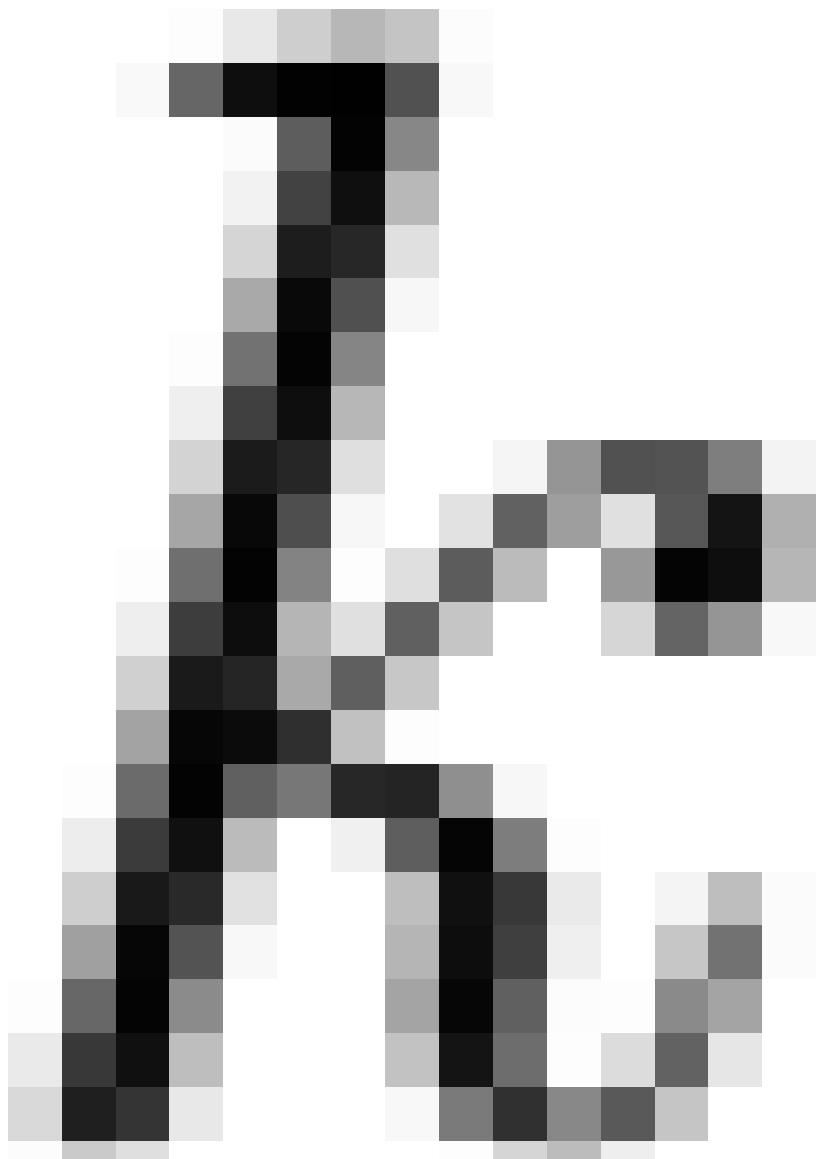
=

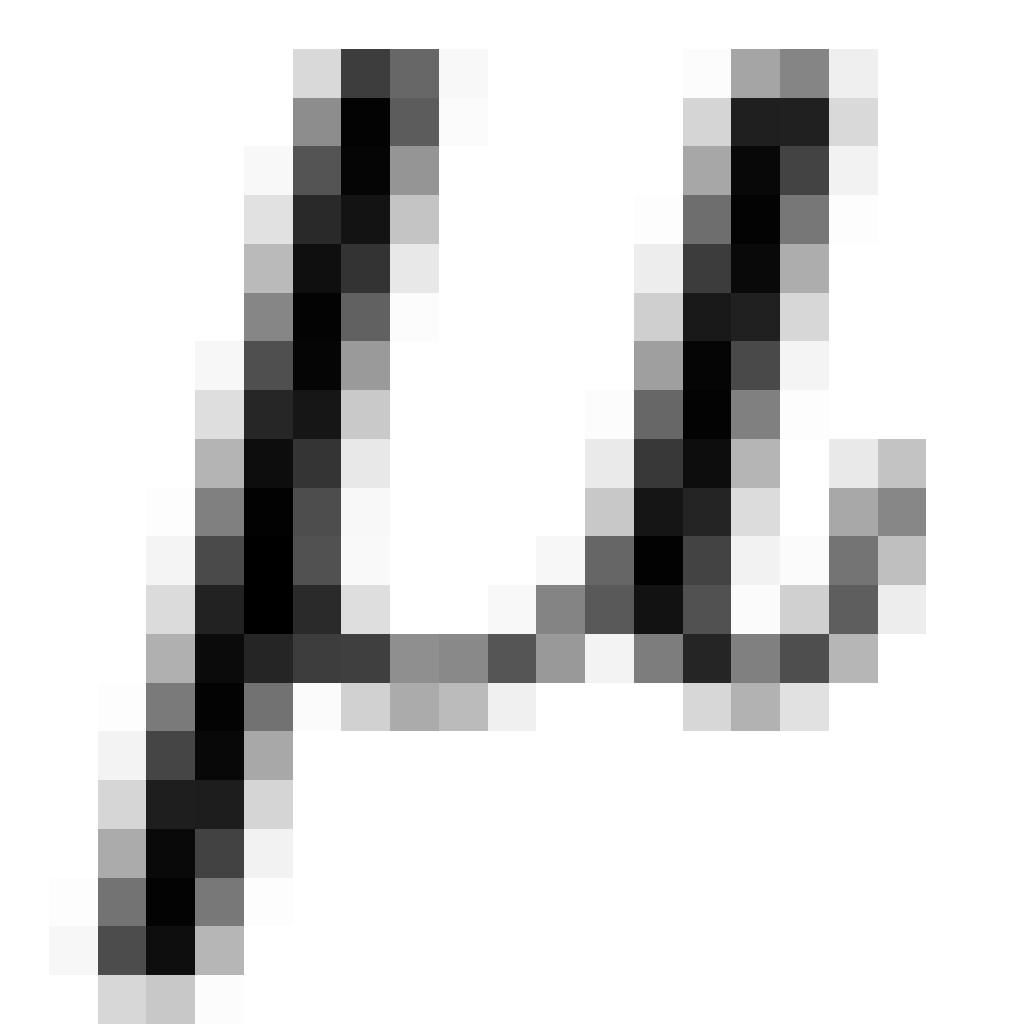
MK

ll









αP
 p



D_h

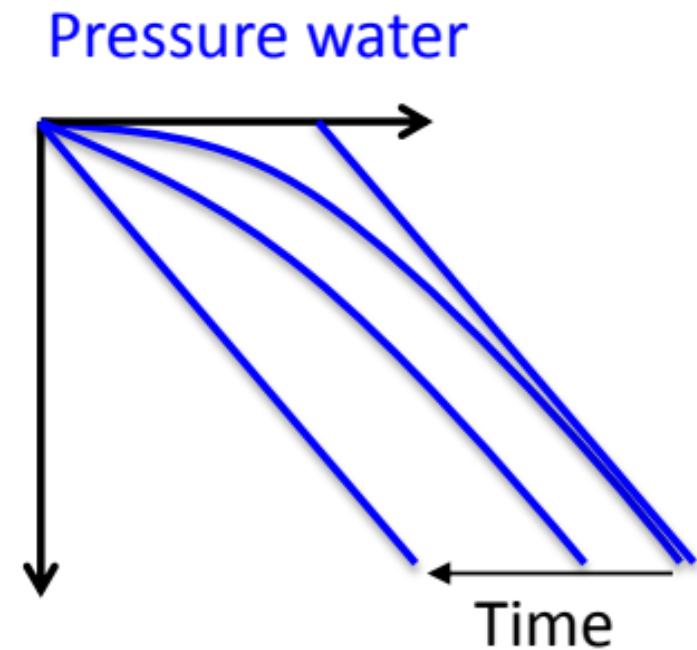
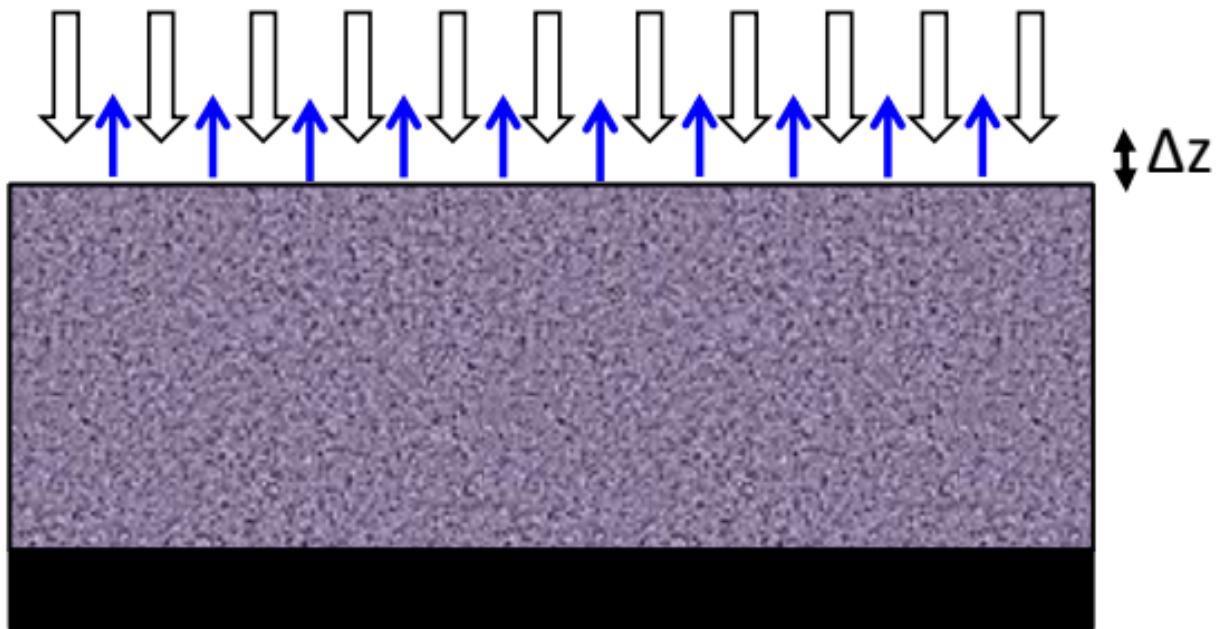
$d^2 P$
 p

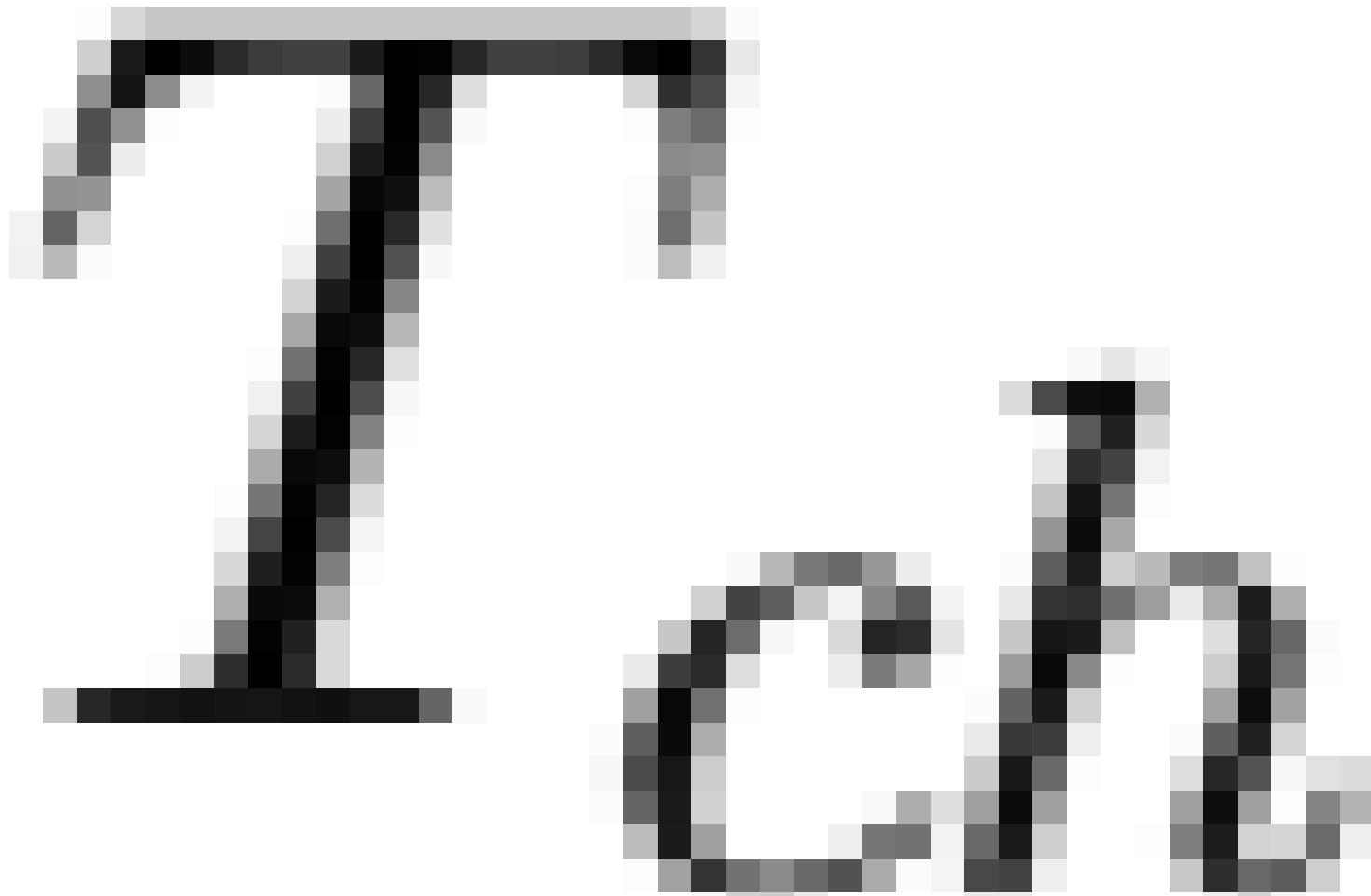


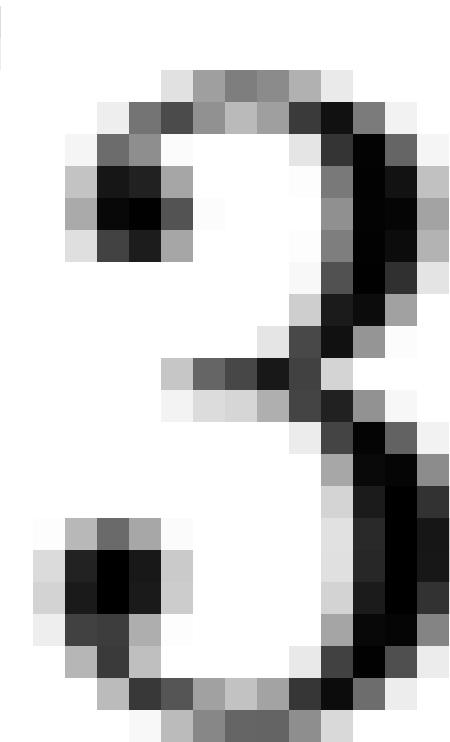
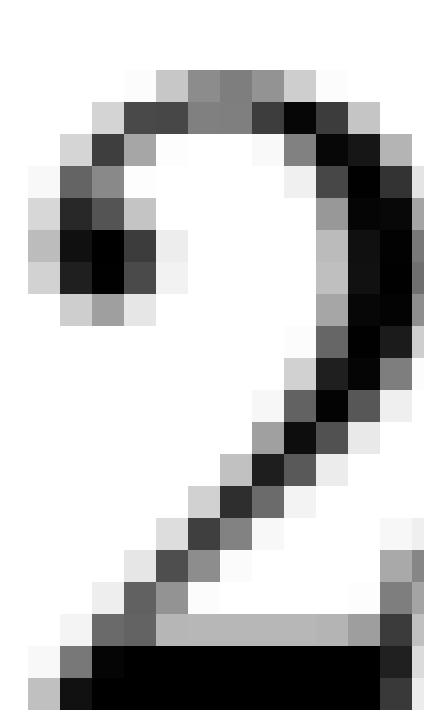
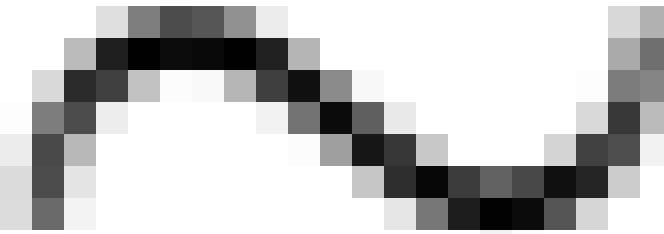
αt

$d z^2$

Rate of sedimentation (loading) and rate of fluid “escape”





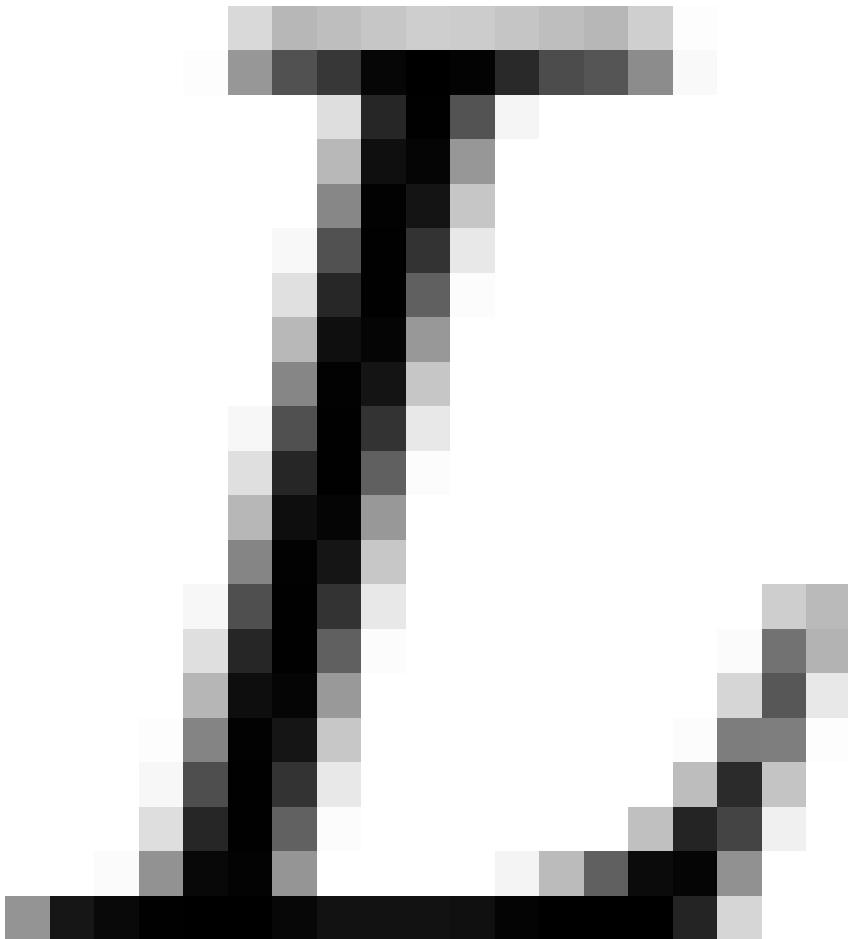


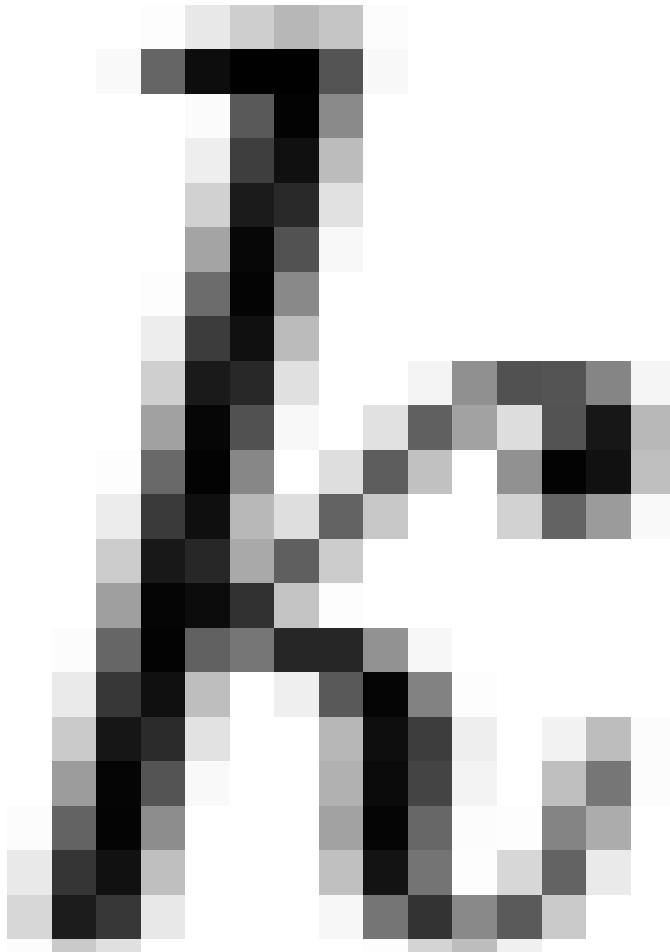
Γ_{ch}

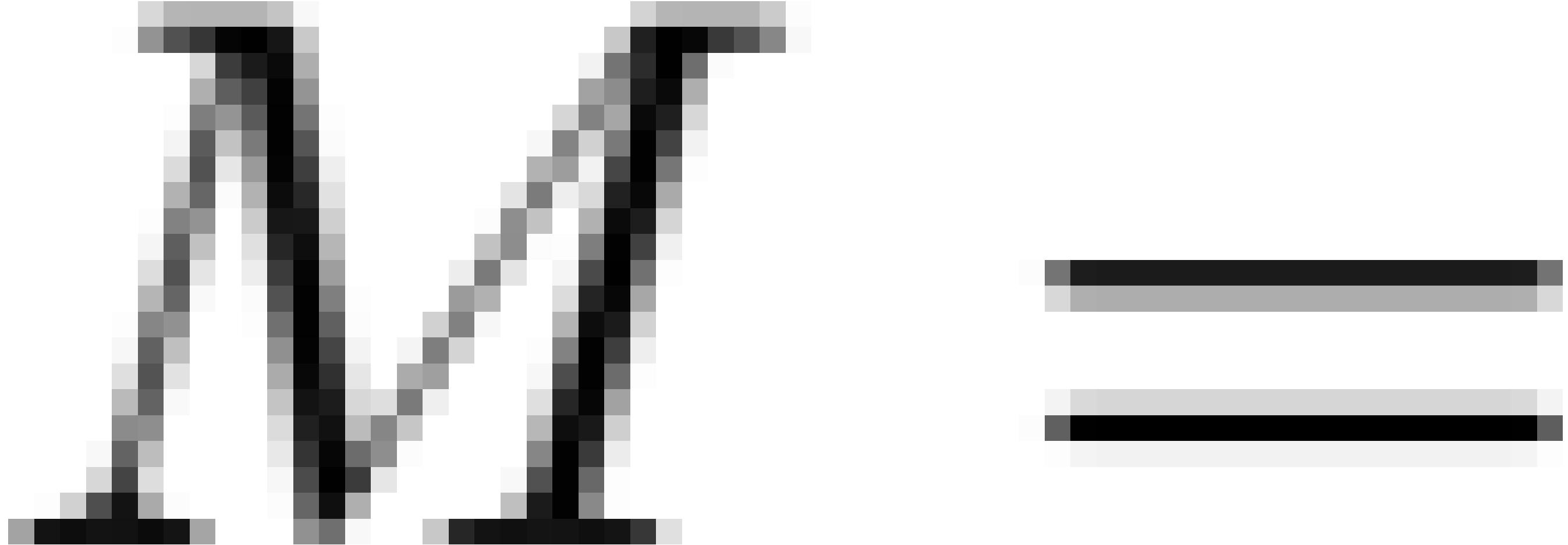


D_h

Γ^2

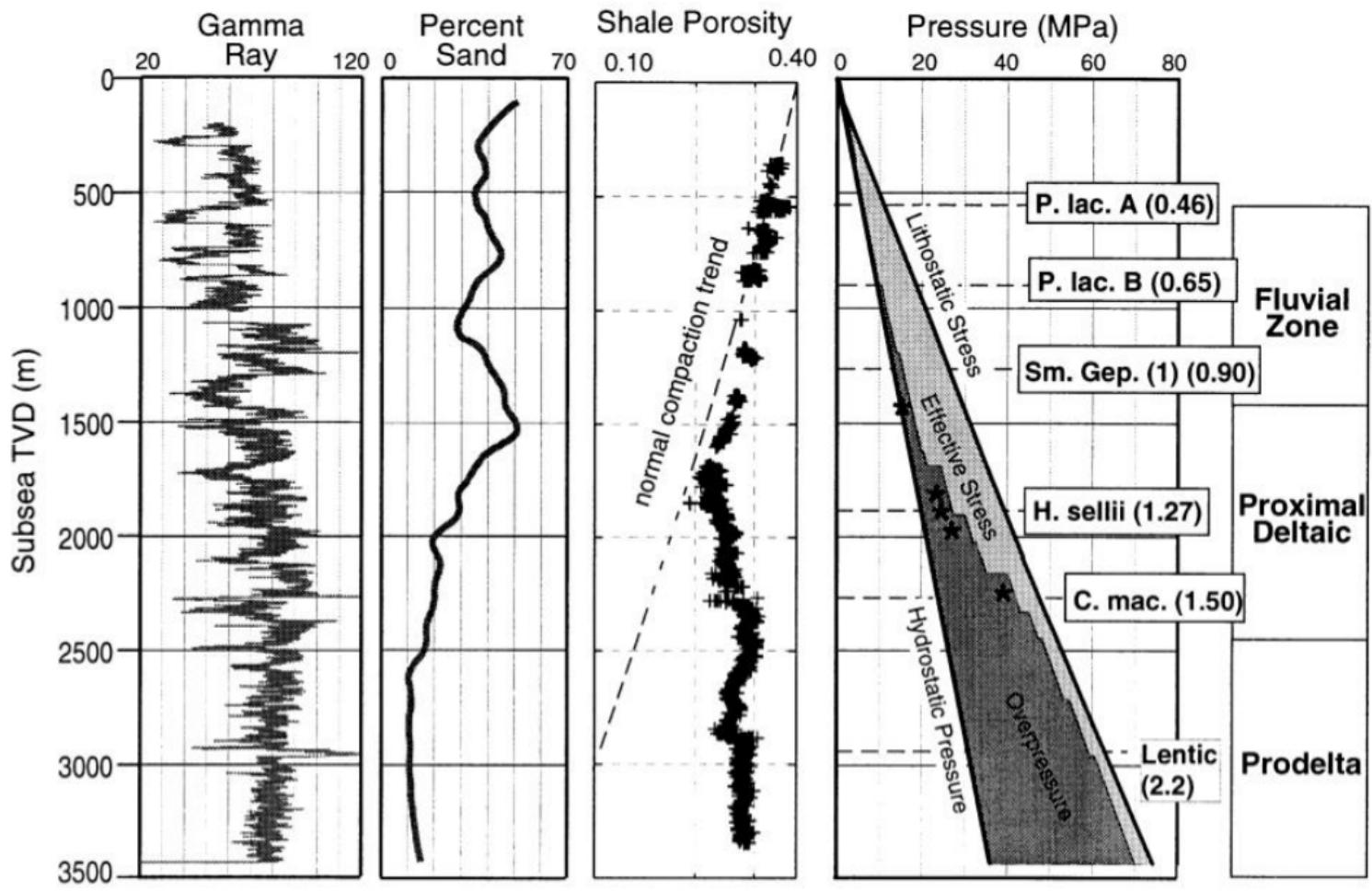




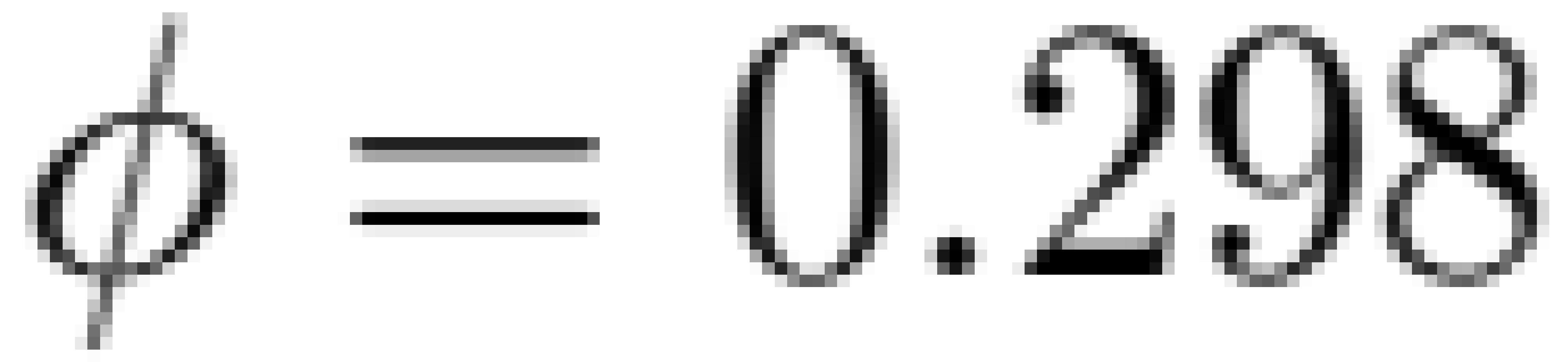


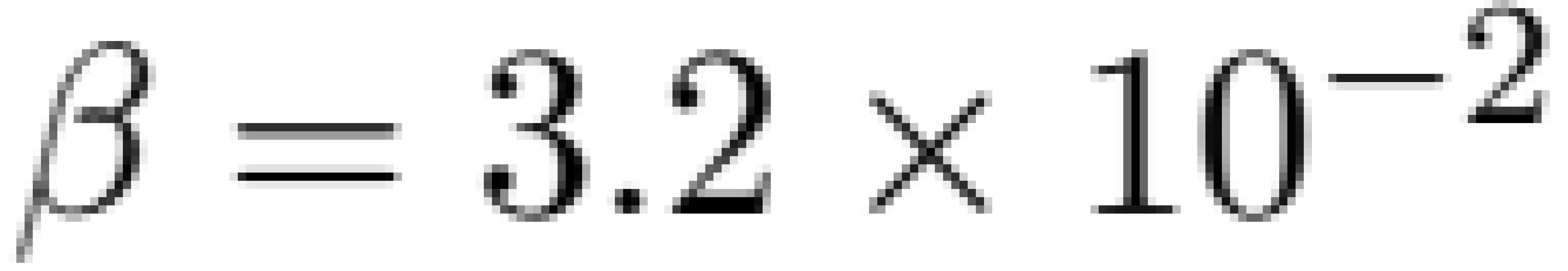


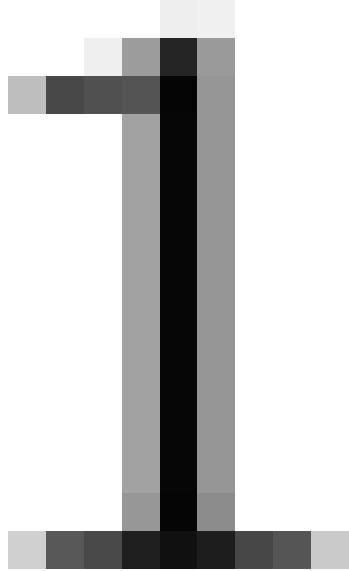


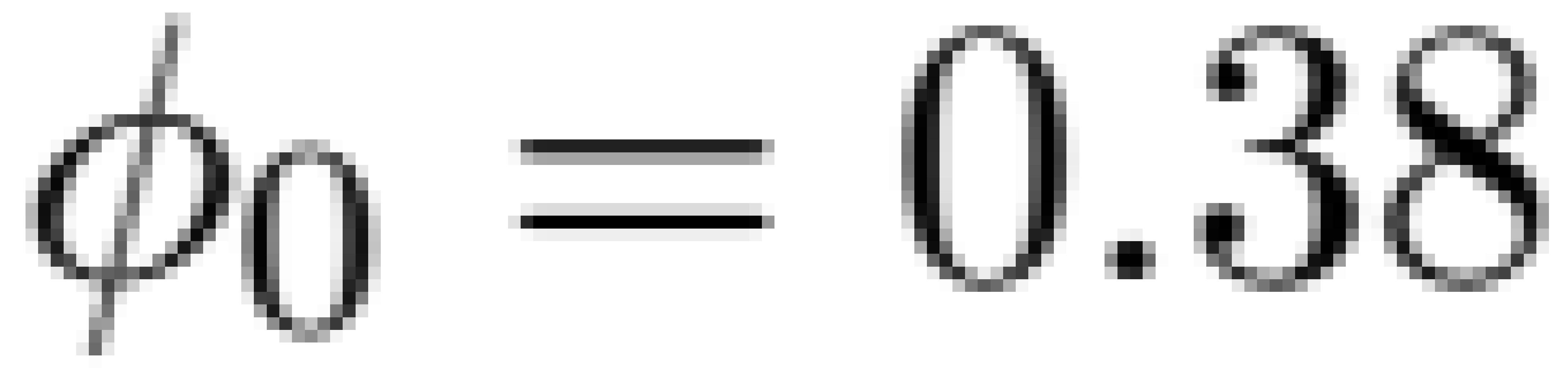


Off-shore Louisiana – Gordon and Flemings (1998) Basin Research



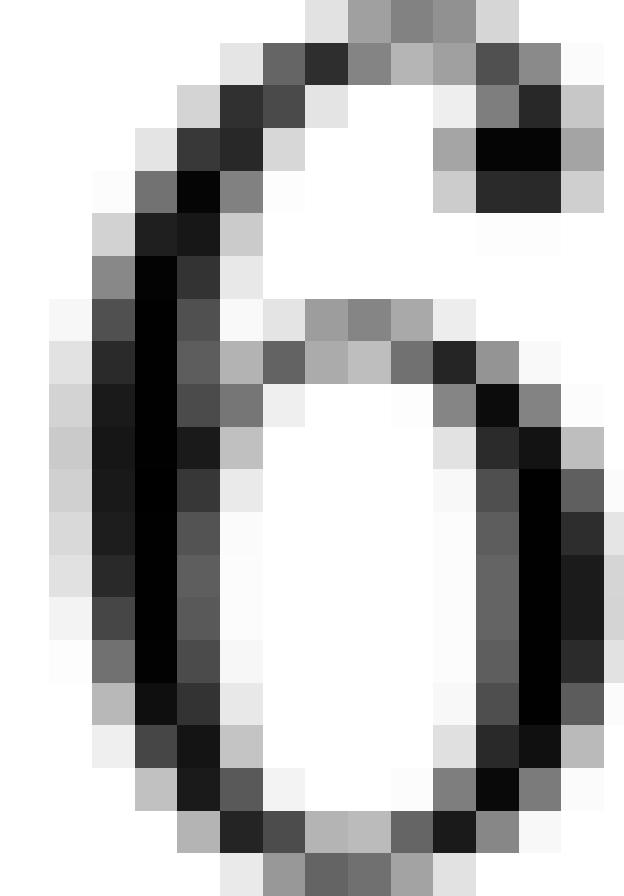
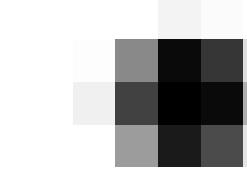
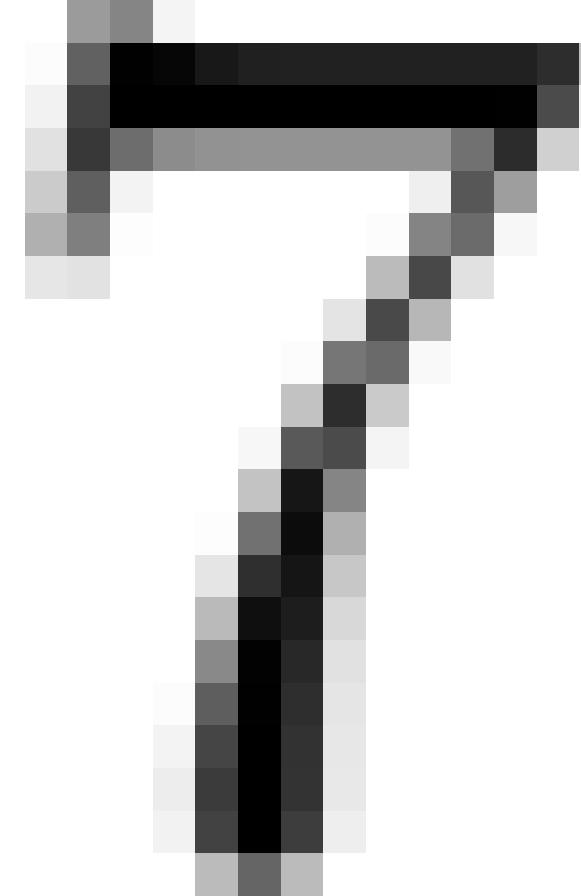


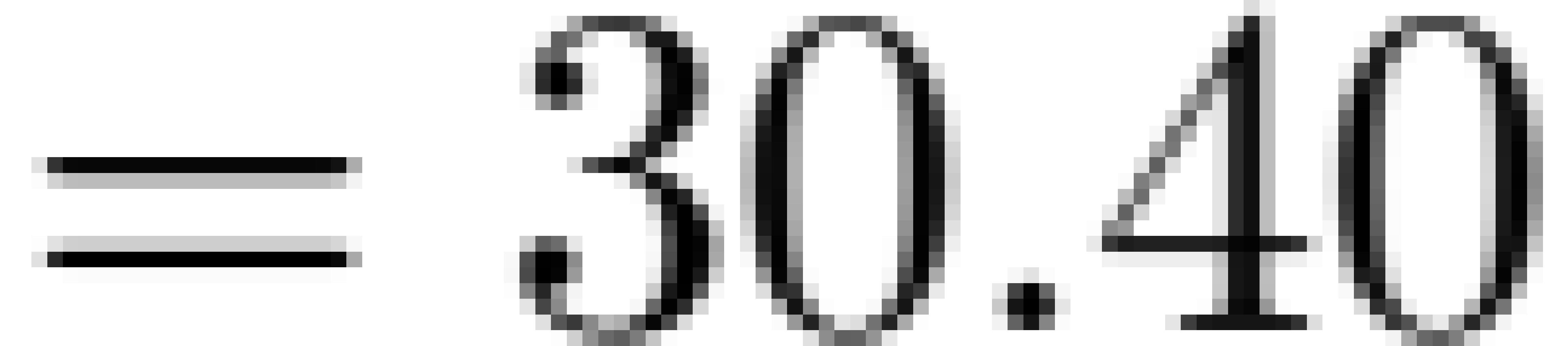




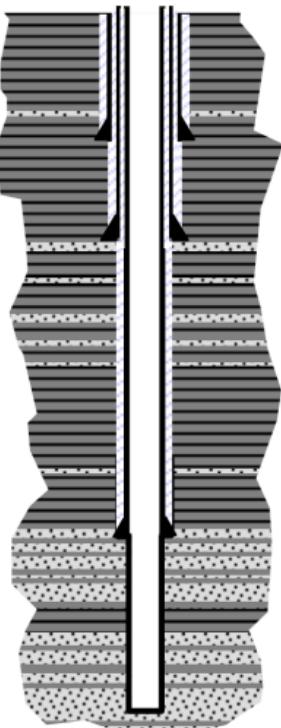
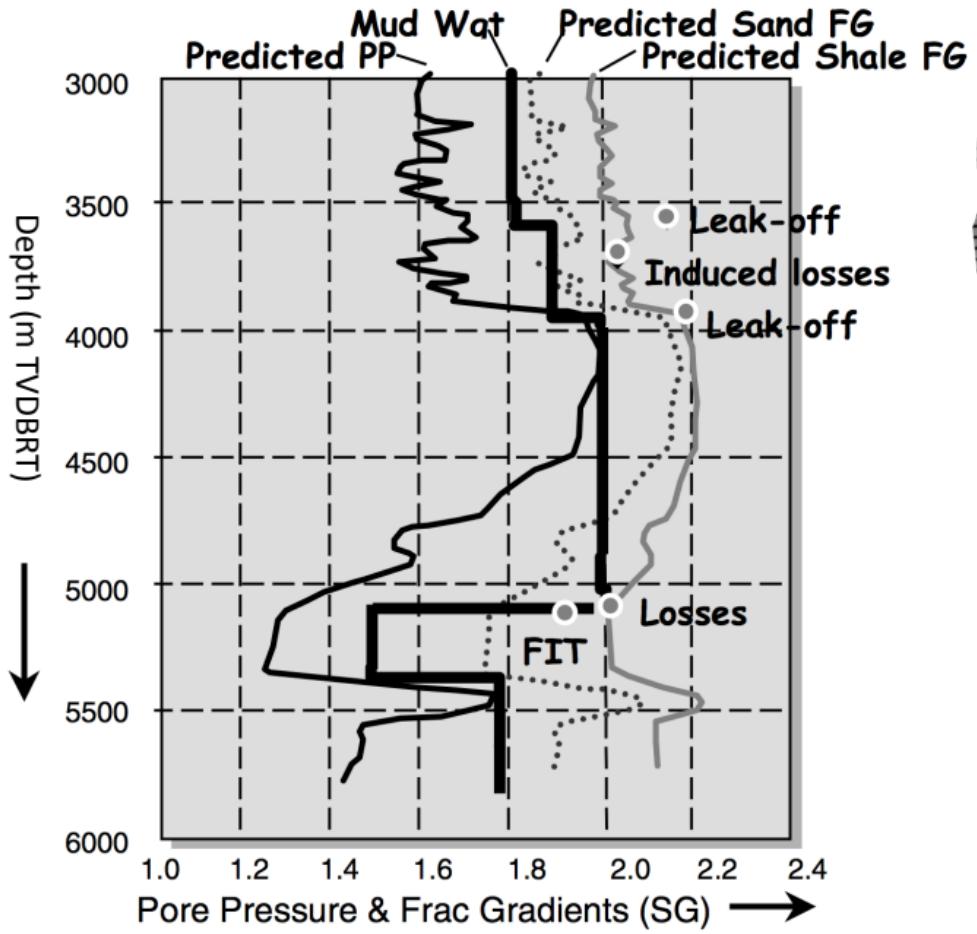


$$P_p = S_v + \frac{\ln \left(\frac{\phi}{\phi_0} \right)}{\beta} = 38$$





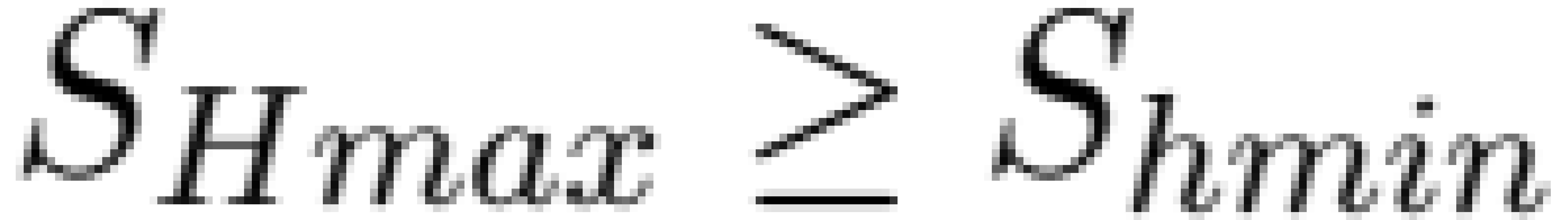
P = 30.40 MPa
 S_2 = 0.8.
38 MPa

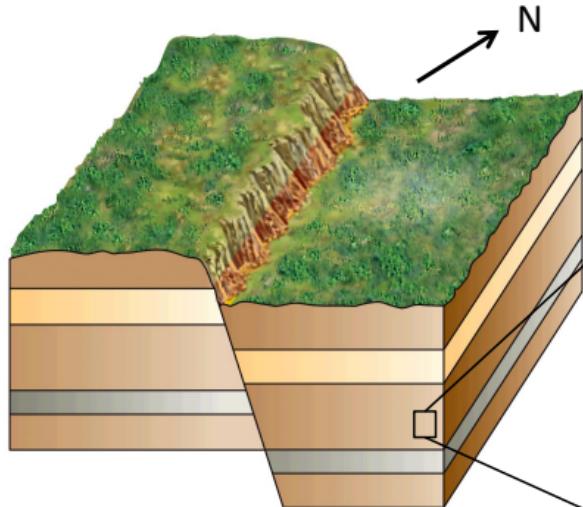


[Caspian Sea, Alberta and McLean – SPE67740]

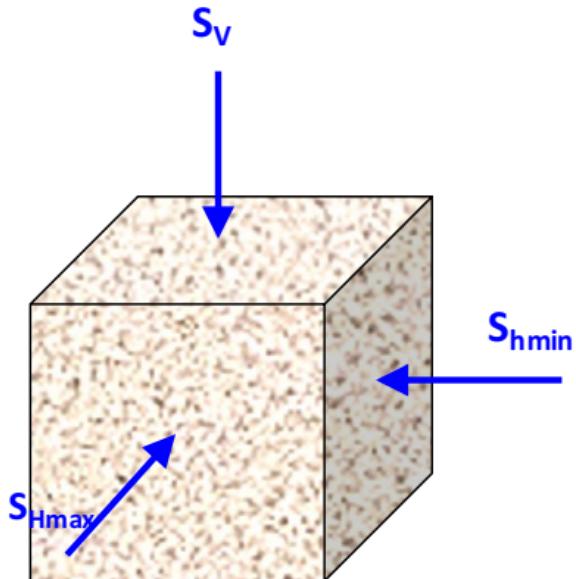




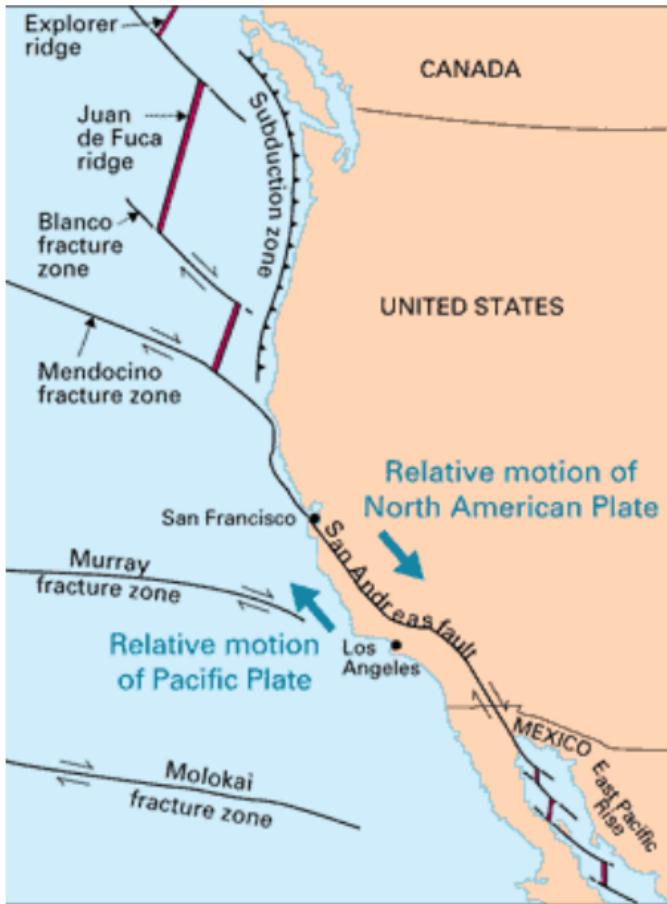




1
2
3

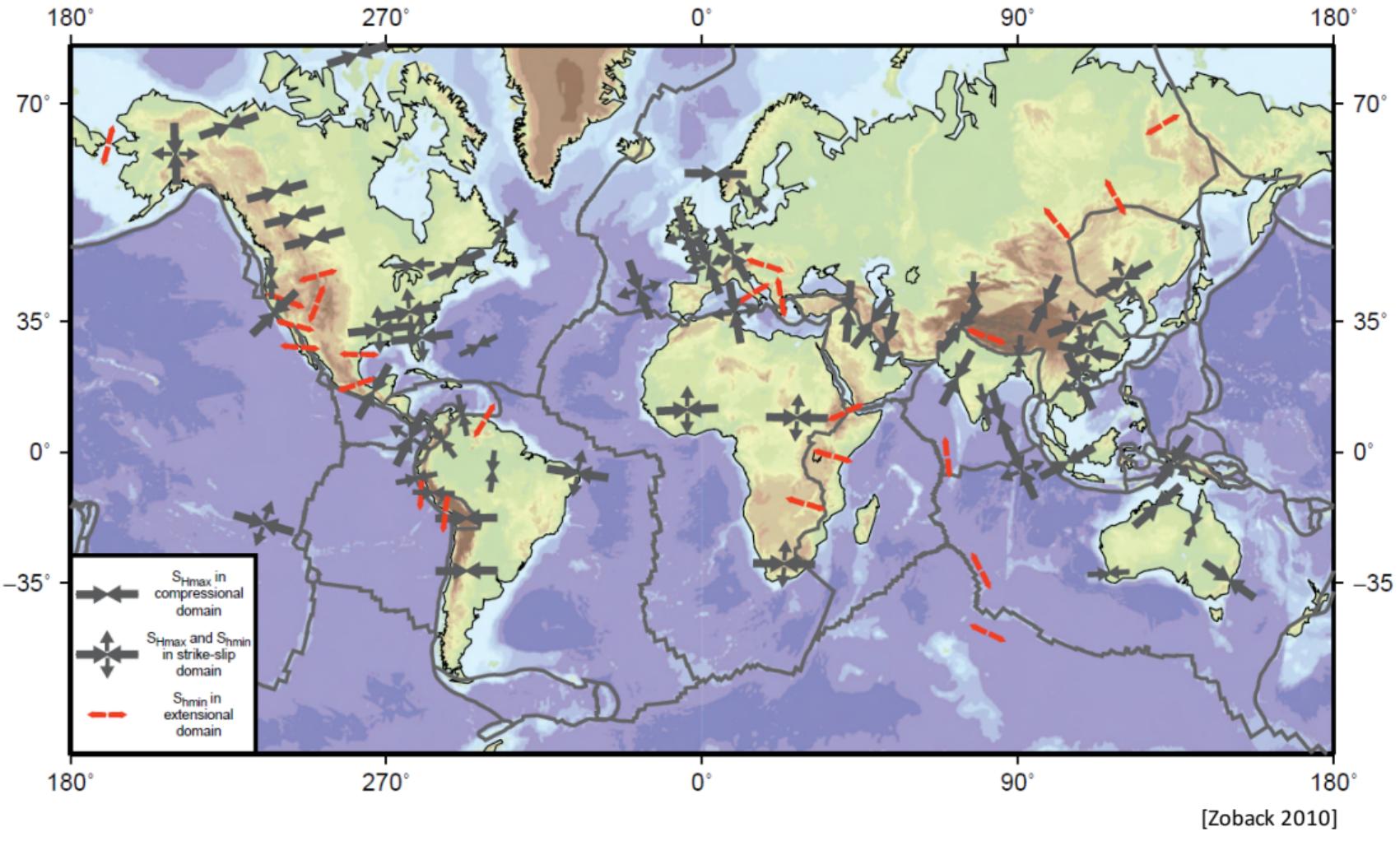


$$S = \begin{bmatrix} S_V & 0 & 0 \\ 0 & S_{H\max} & 0 \\ 0 & 0 & S_{h\min} \end{bmatrix}$$

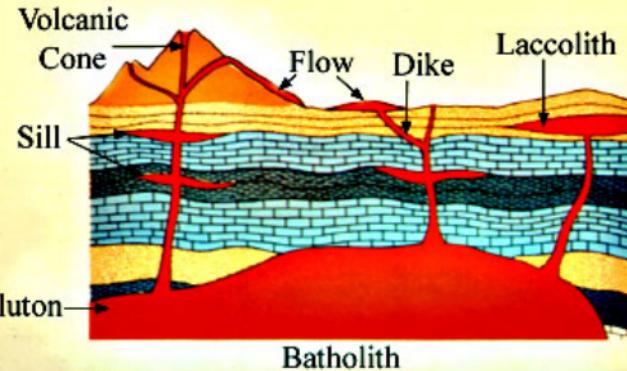


<http://pubs.usgs.gov/gip/dynamic/understanding.html#anchor5798673>

<http://en.wikipedia.org/wiki/File:Aerial-SanAndreas-CarrizoPlain.jpg>



PLUTONS & VOLCANIC LANDFORMS





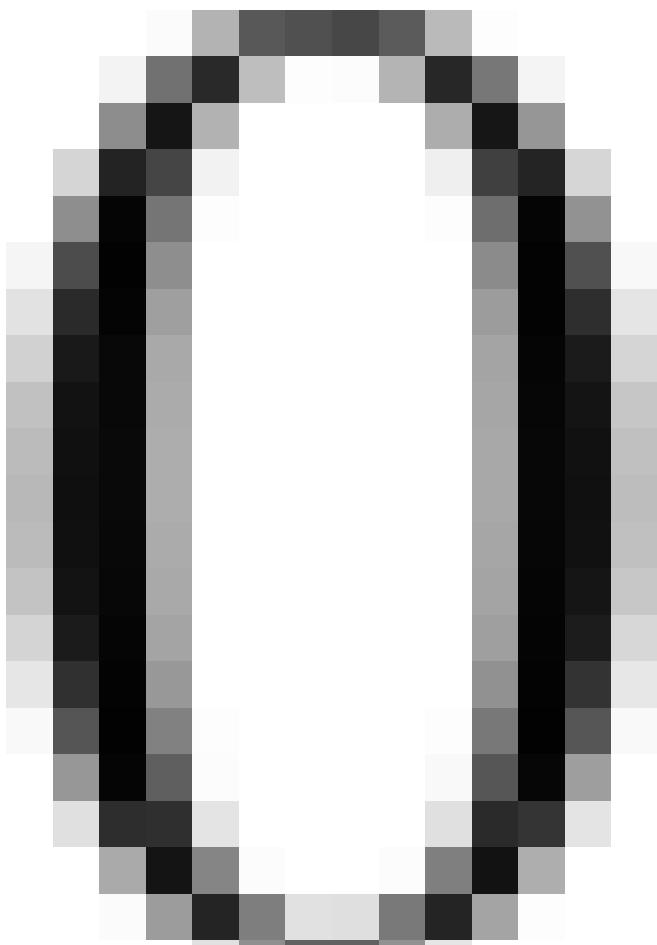
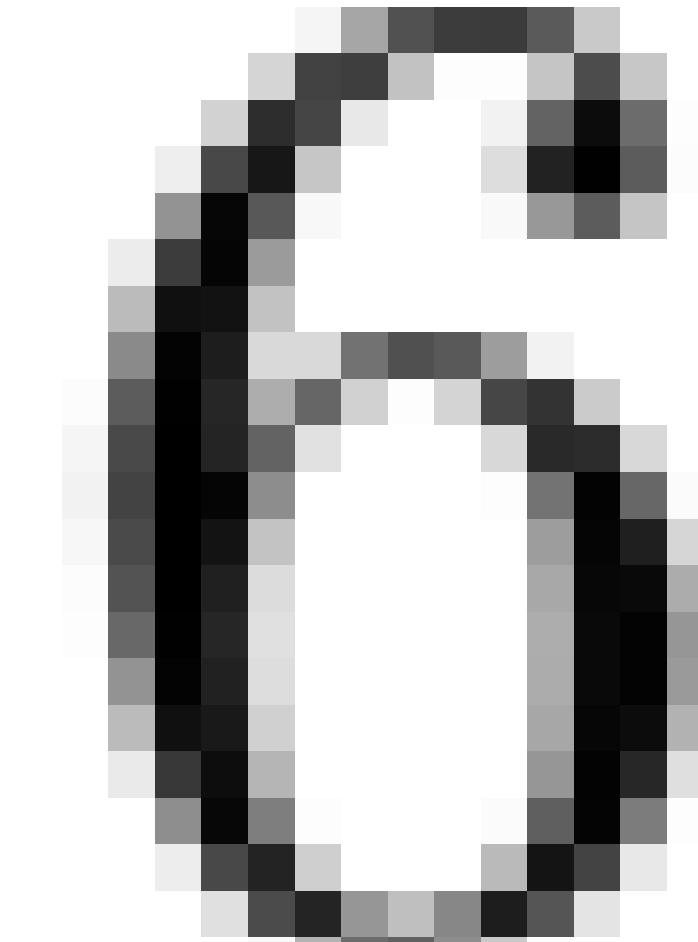
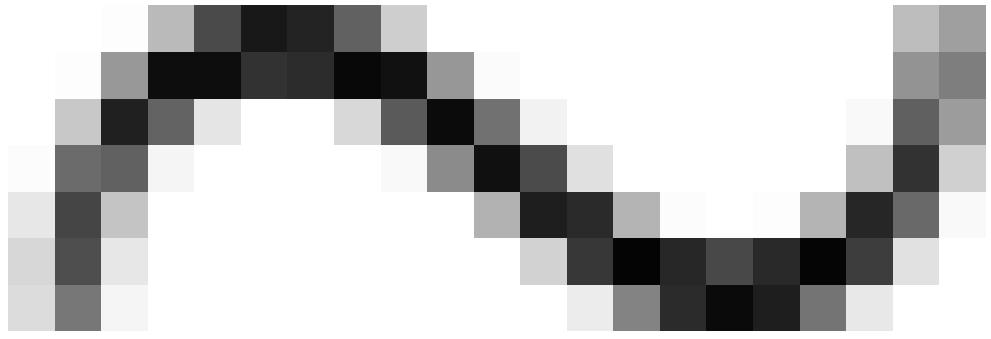








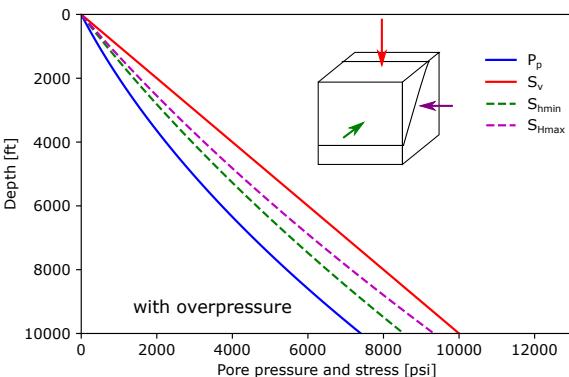
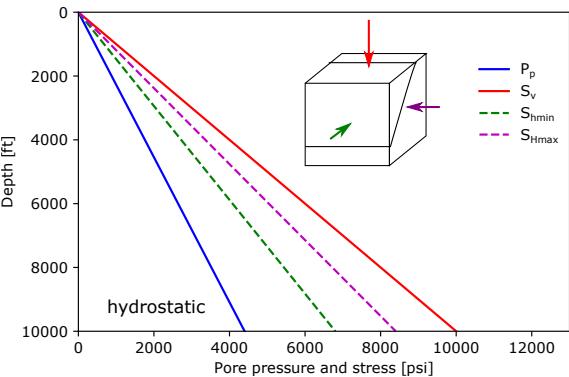




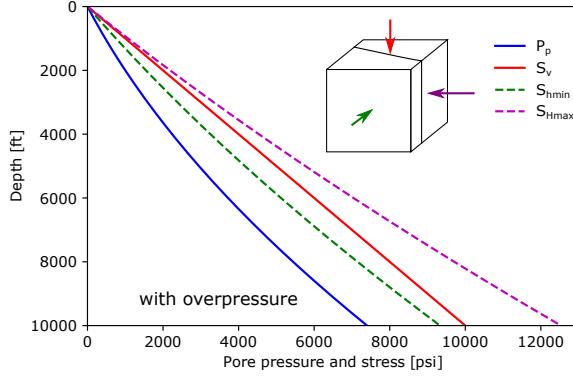
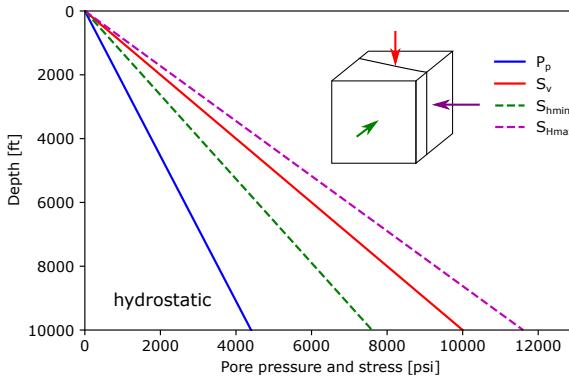




Normal faulting: $S_v > S_{H\max} > S_{h\min}$



Strike slip faulting: $S_{H\max} > S_v > S_{h\min}$



Reverse faulting: $S_{H\max} > S_{h\min} > S_v$

