- What is sand?
- Where does it come from?
- Waves and wave energy
- How global climate change will influence waves and wave transport
- Dune types and formation
- Natural dune communities
- Introduced beachgrass and influence on beach and dunes
- Surf zone and sand dwelling organisms and food web
- Snowy plover biology
- Oregon beach law
- Field trip

What is sand?

- Size: 1/16 mm to 2 mm
- Composition: mainly quartz, augite, hornblende (green and brown), hypersthene, and garnet
  - Augite dominates: Tillamook Head to Cape Foulweather
  - Hornblende and hypersthene: Columbia River to Tillamook Head, Cape Foulweather south
  - Garnet: increases to the south, though a smaller component everywhere

Where does sand come from?

- Rivers?

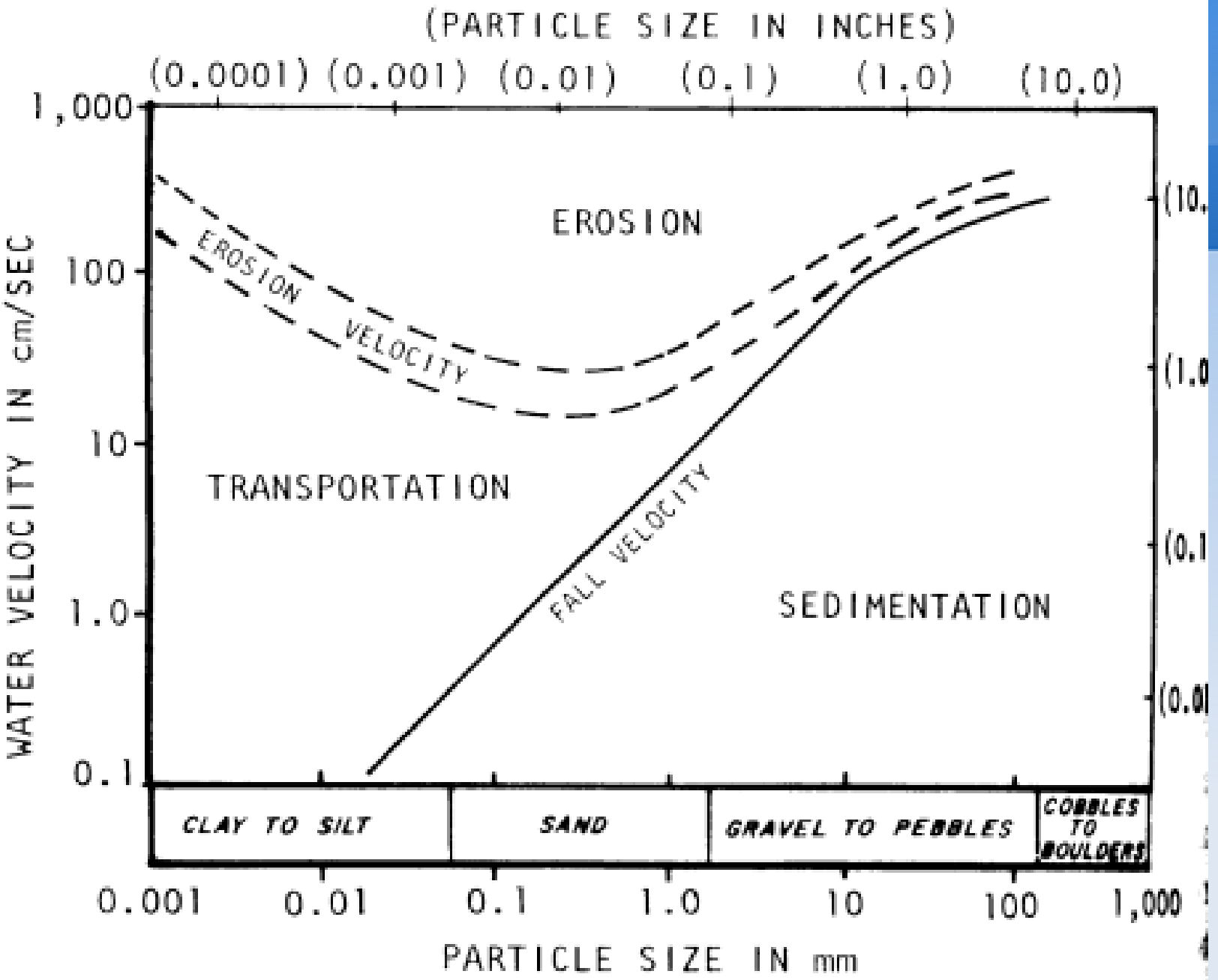
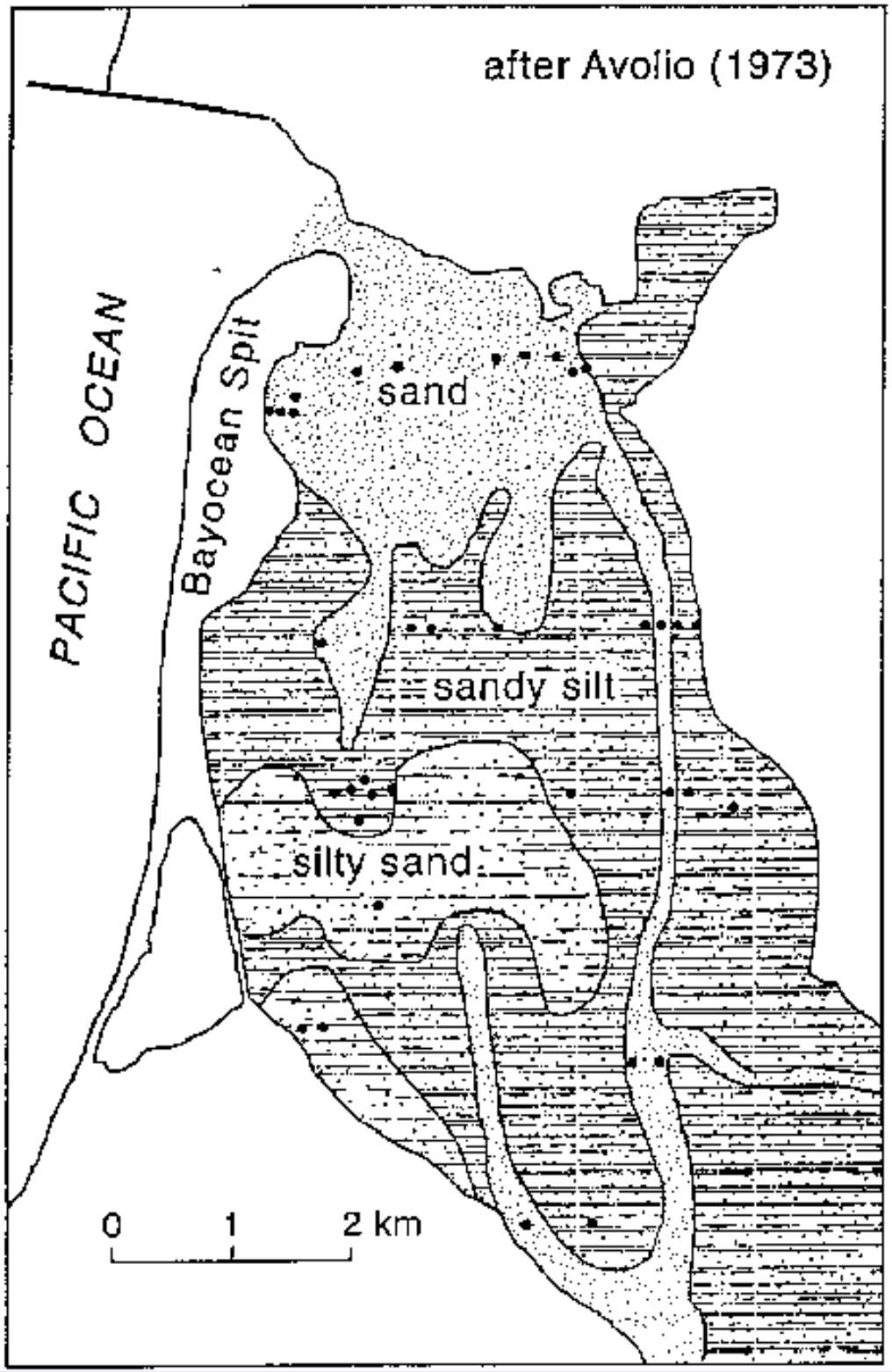
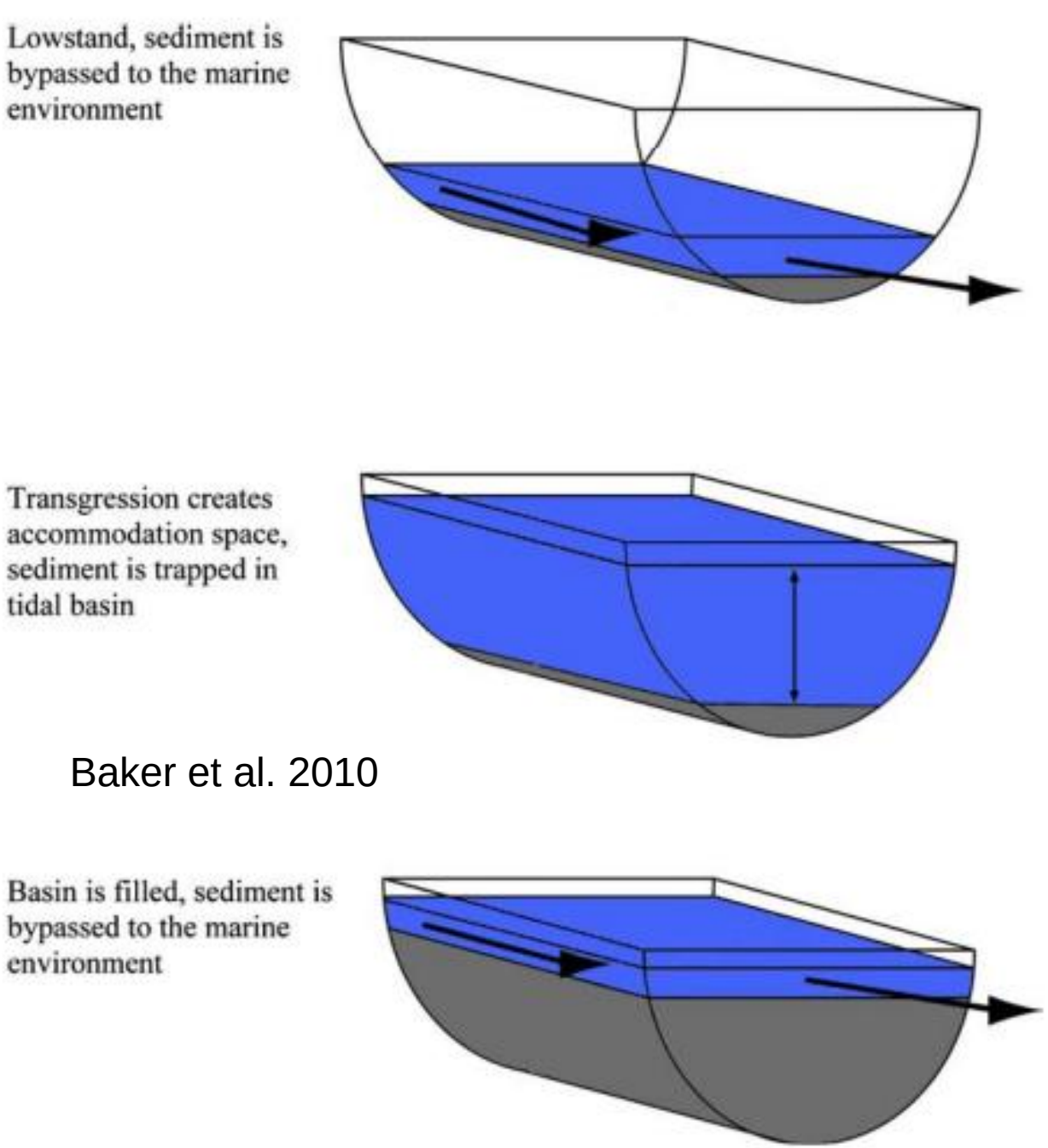


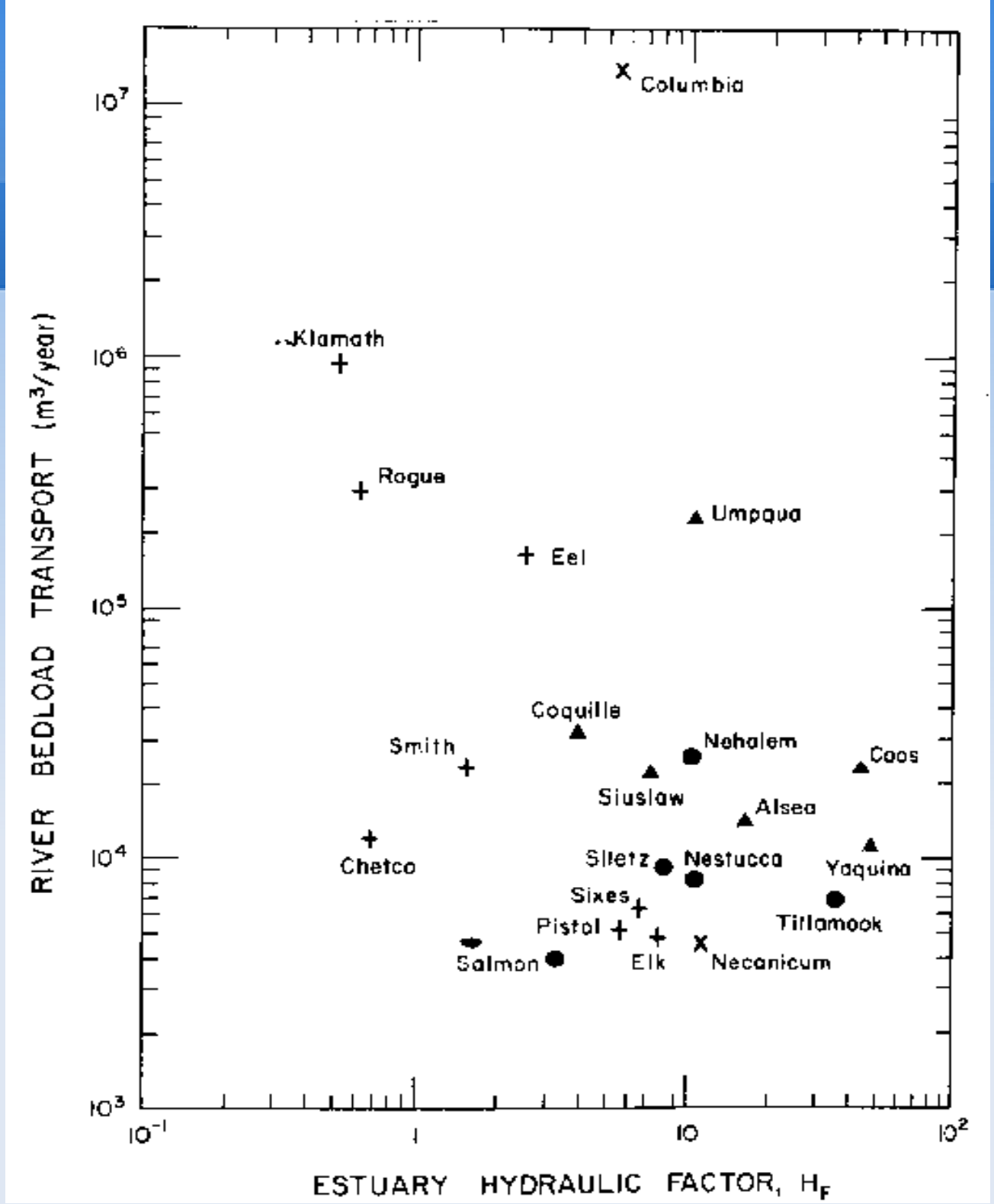
Figure 42. Curves of Erosion and Deposition for Uniform Material. velocity is shown as a band. Particle types (names), from clay to boulde based on size. (From Morisawa, 1968, and Shepard, 1963.)

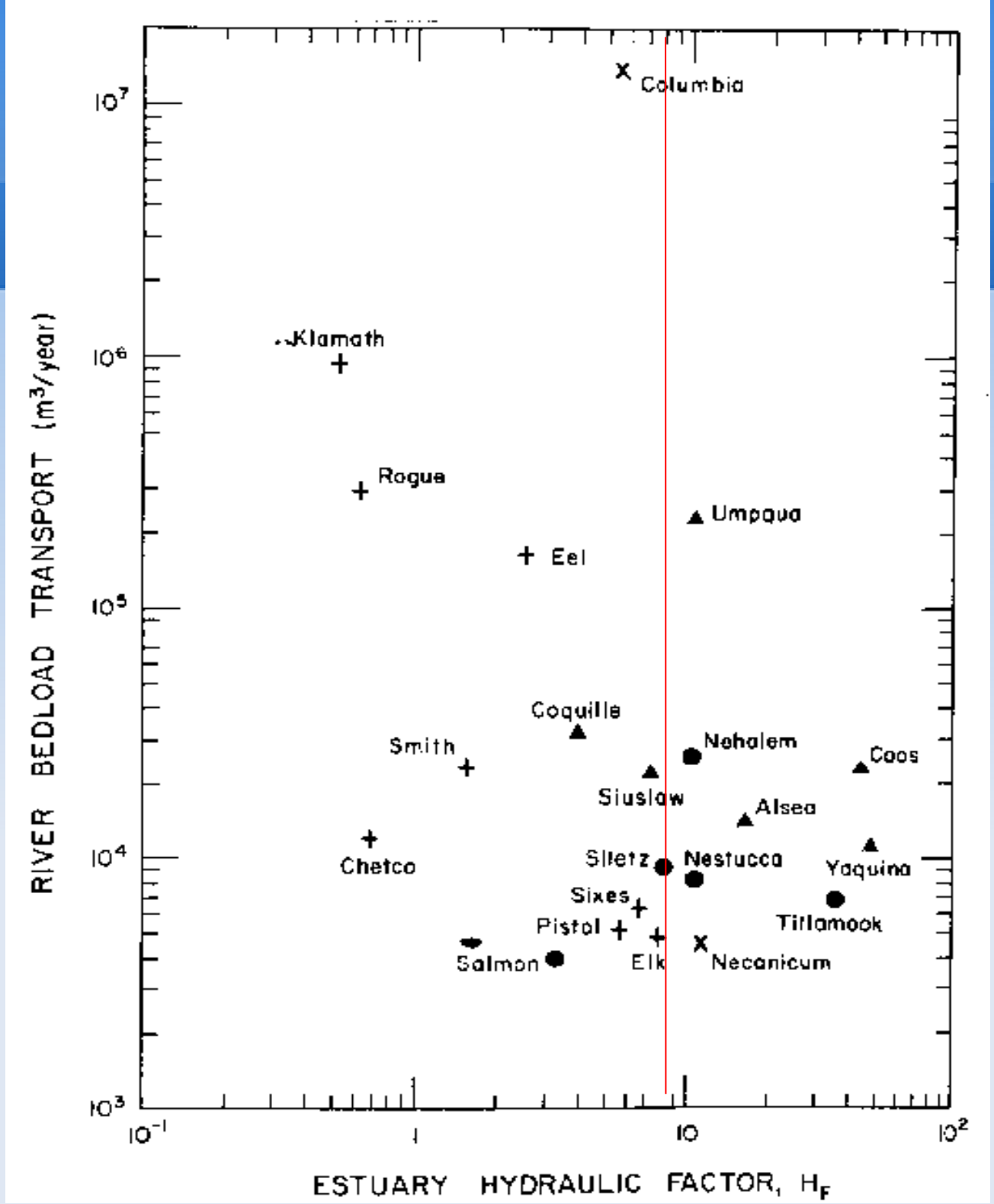

after Avolio (1973)
PACIFIC OCEAN
Bayocean Spit
sand
sandy silt
silty sand
0
1
2 km



Baker et al. 2010

Fig. 15. Diagram of the Holocene transgression induced accommodation space. Two factors, i.e. rapid sea level rise and broad valley geometry, created abundant accommodation space as the Columbia River was submerged.


Columbia
Klamath
Rogue
Umpqua
Eel
Coquille
Smith
Nehalem
Coos
Siuslaw
Alsea
Chetco
Siletz
Nestucca
Yaquina
Sixes
Tillamook
Pistol
Salmon
Elk
Necanicum
RIVER BEDLOAD TRANSPORT (m³/year)
ESTUARY HYDRAULIC FACTOR, H_F
10^7
10^6
10^5
10^4
10^3
10^{-1}
1
10
10^2


Columbia
Klamath
Rogue
Umpqua
Eel
Coquille
Smith
Nehalem
Coos
Siuslaw
Alsea
Chetco
Siletz
Nestucca
Yaquina
Sixes
Tillamook
Pistol
Salmon
Elk
Necanicum
RIVER BEDLOAD TRANSPORT (m³/year)
ESTUARY HYDRAULIC FACTOR, H_F
10⁷
10⁶
10⁵
10⁴
10³
10⁻¹
1
10
10²

Where does sand come from?

- Rivers?
- Local erosion?

Origins of beach/dune sand

- Columbia/Umpqua Rivers
  - hypersthene
- Coast range volcanic source
  - augite
- Klamath Mtns. metamorphic source
  - garnet

Clemens and Komar 1988

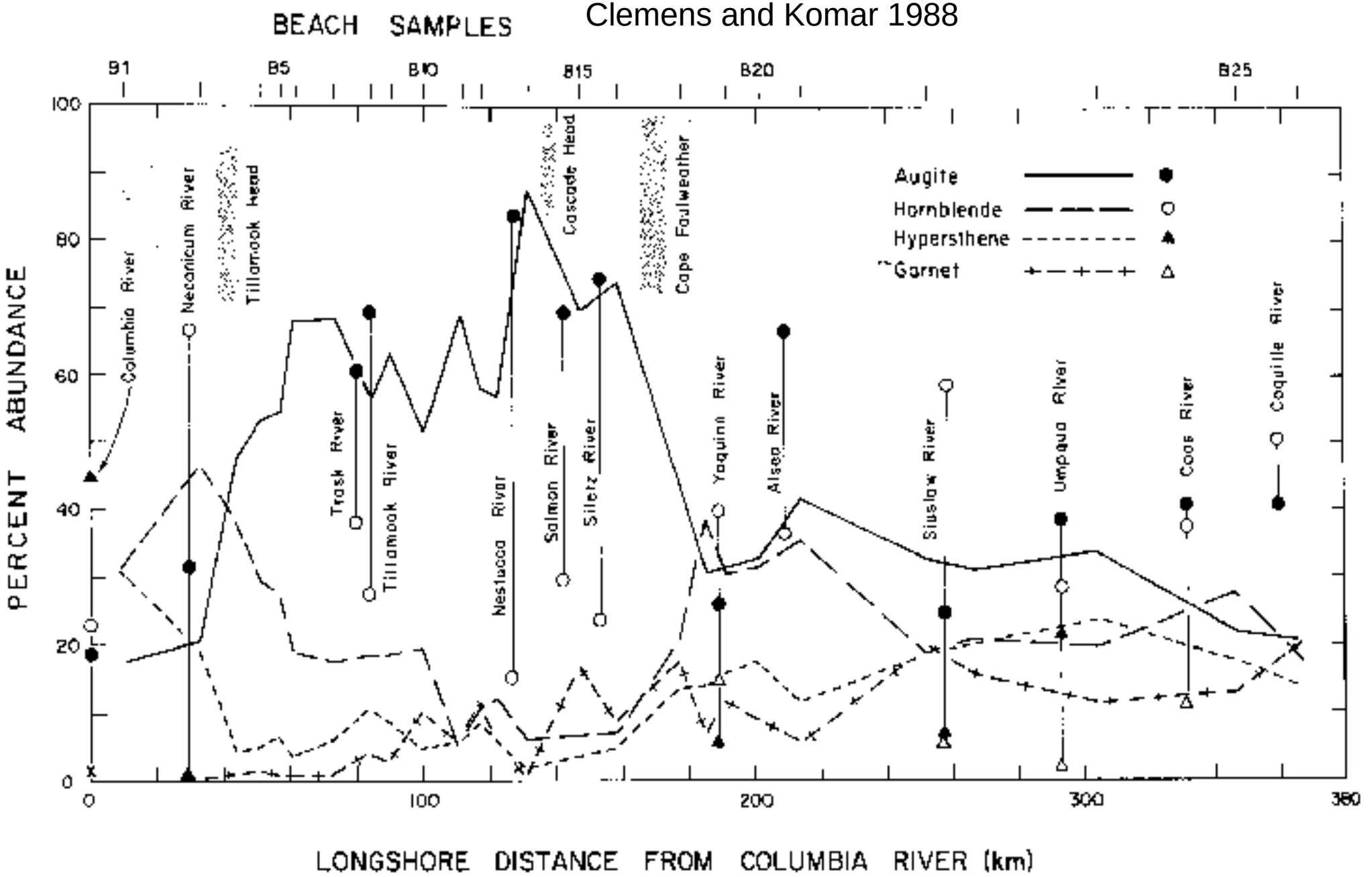


FIG. 2.—Variations in the percent abundances of the principal heavy minerals found in the beach-sand samples. Also plotted are the compositions of the river sands, and the positions of Tillamook Head, Cascade Head and Cape Foulweather, the major headlands which apparently have some control on the beach mineralogies.

Angular

Round

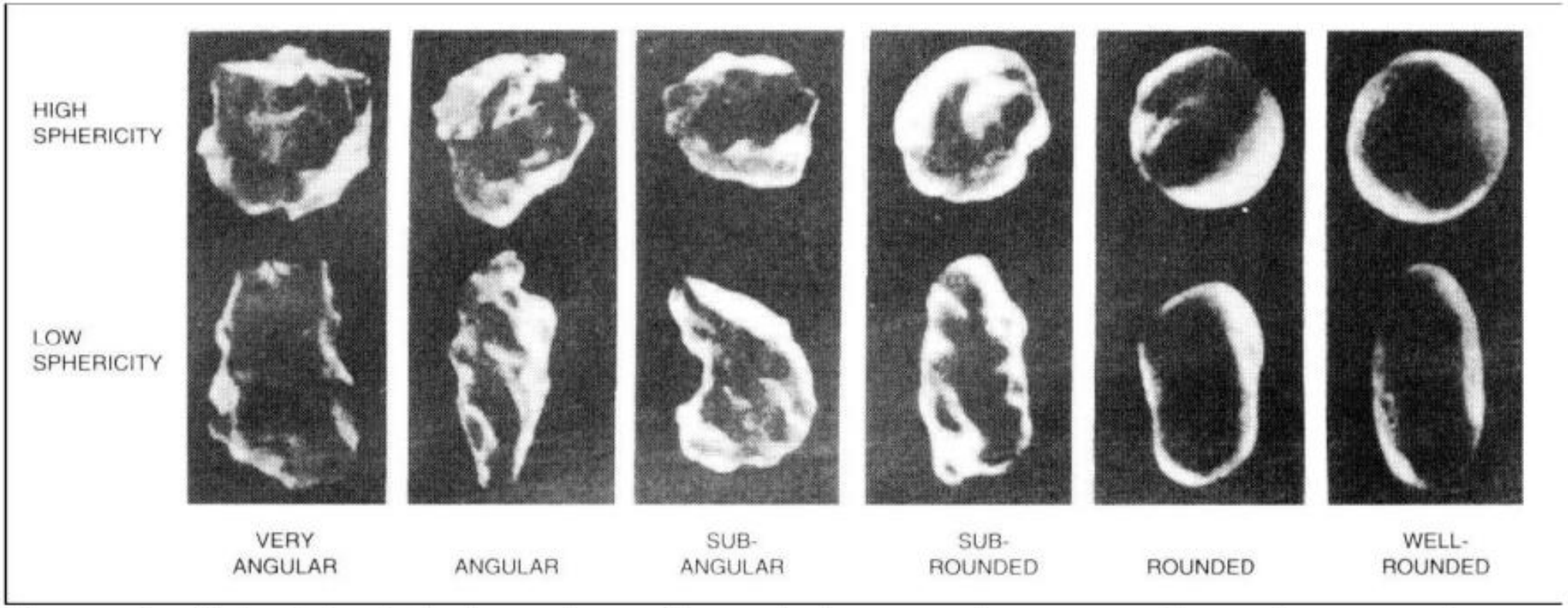


Figure 2. Sphericity is independent of roundedness, and measures how close a grain comes to being spherical or elongate.

Clemens and Komar 1988

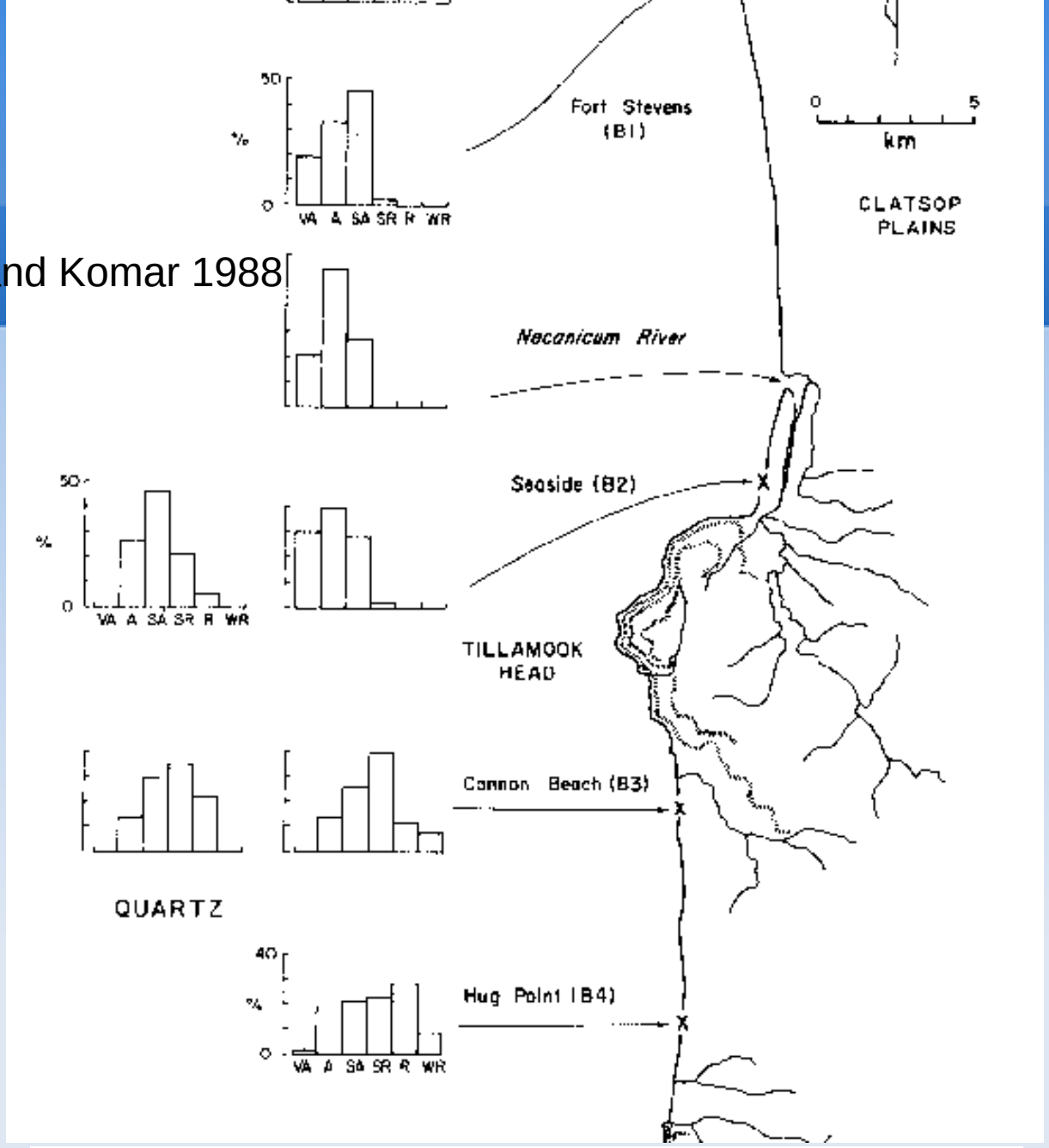


FIG. 5.—Histograms of the rounding of augite grains in the Columbia and Necanicum rivers and in the beach-sand samples from the Columbia south to Manzanita Beach. Also included are roundness histograms for quartz in the beach sands immediately north and south of Tillamook Head. (VA = very angular, A = angular, SA = subangular, SR = subrounded, R = rounded, WR = well rounded.)

Clemens and Komar 1988

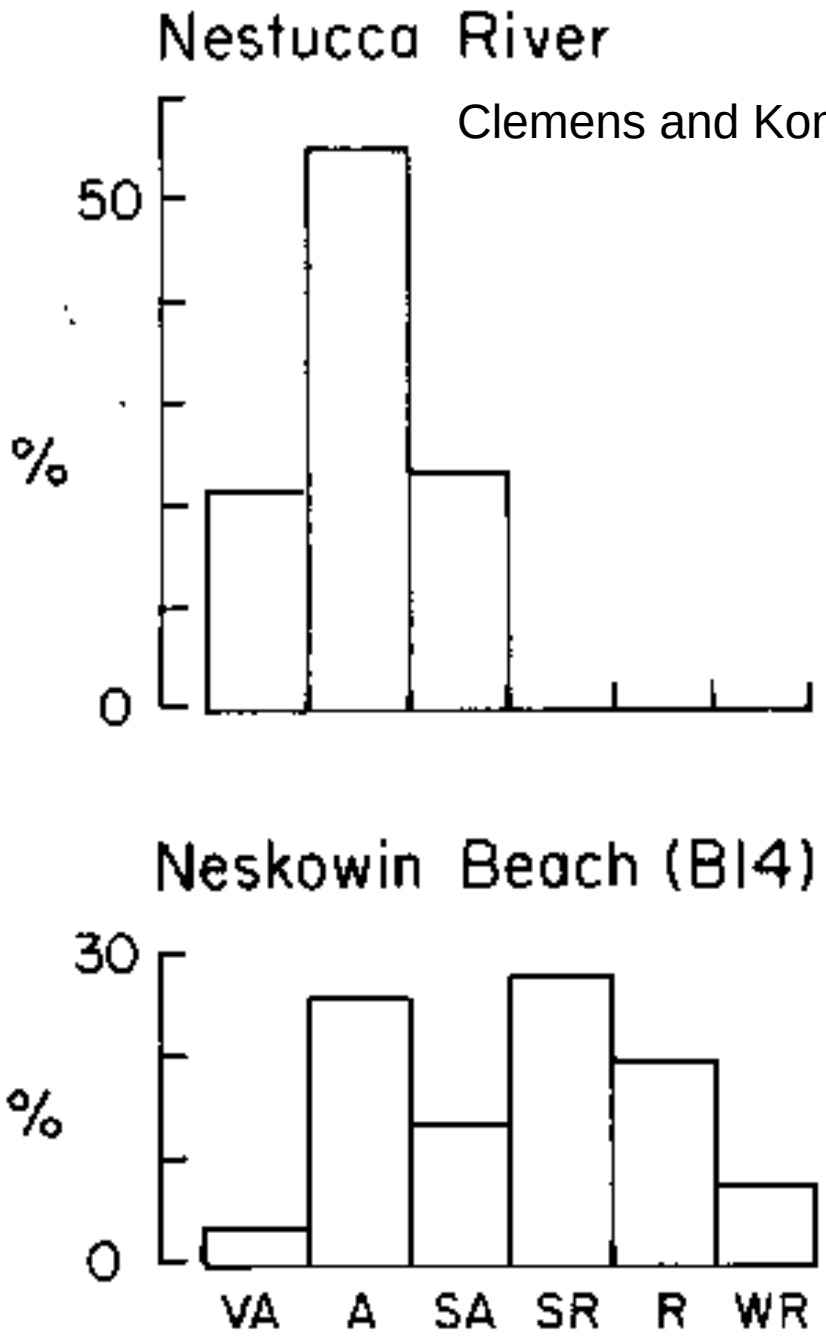


FIG. 6.—Histograms of the angularity of augite grains in the Nestucca River and Neskowin Beach. (VA = very angular, A = angular, SA = subangular, SR = subrounded, R = rounded, WR = well rounded.)

Peterson et al., 2007

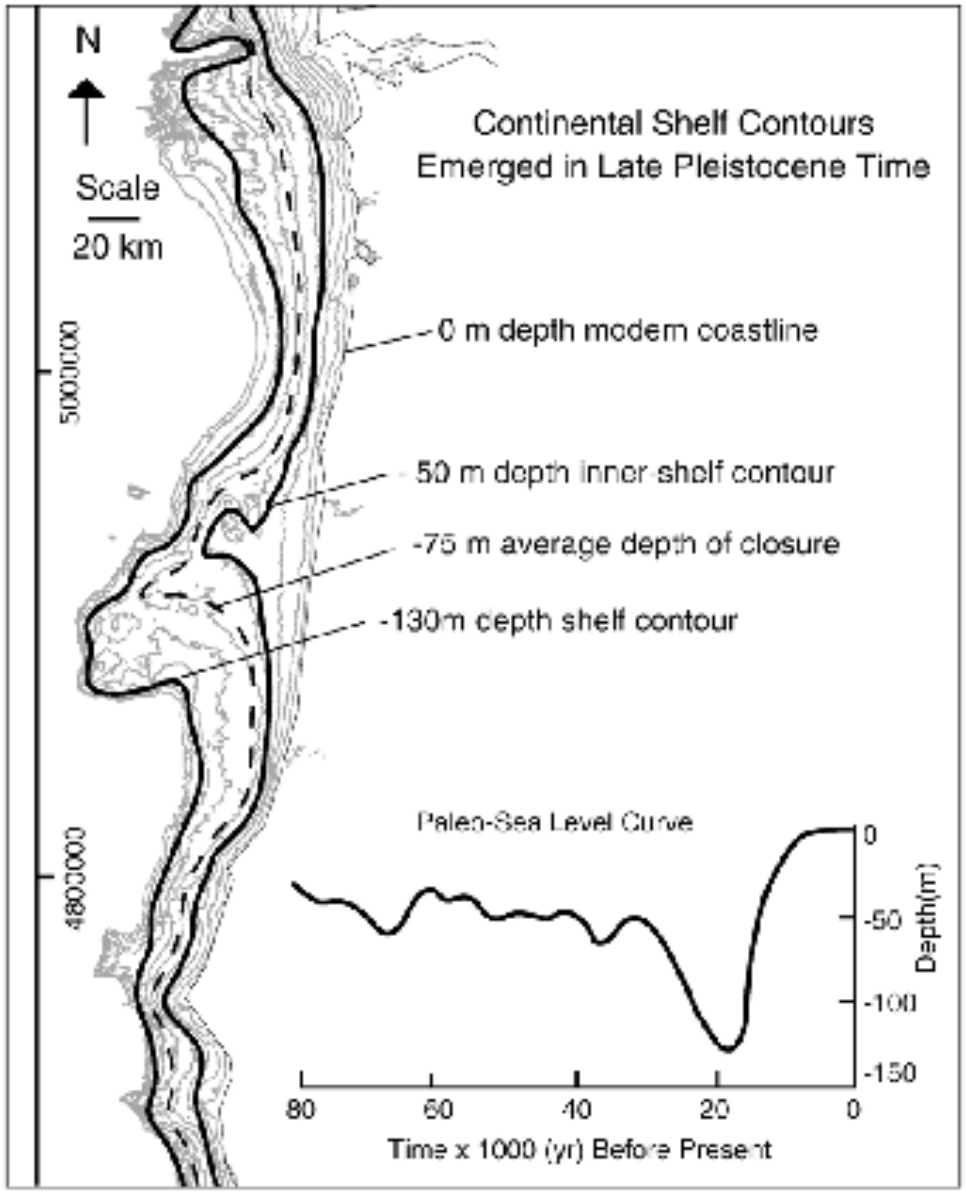
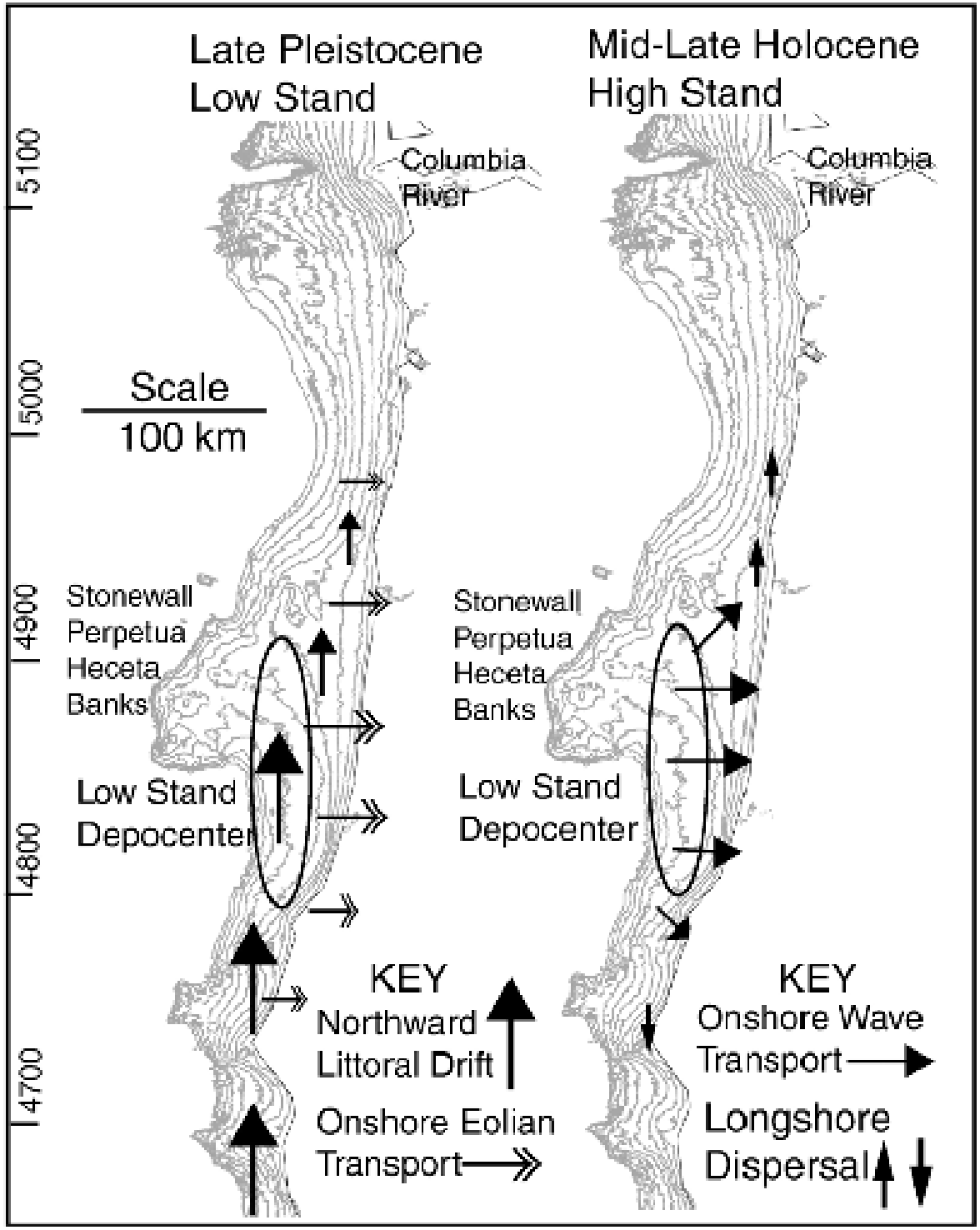


Fig. 4. Map of Oregon continental shelf showing paleo-sea levels (solid lines) at −50 m and −130 m isobaths. A eustatic, sea-level curve is shown for the last 80,000 years (figure redrafted from Pirazzoli, 1993, sea-level curve from Chappell and Shacklelton, 1986). The major period of Late-Pleistocene dune emplacement (30–70 ka) is dominated by sea levels of about 50 m below present sea level. The average depth of closure, e.g., limit of littoral transport (dashed line at −75 m contour), for the late Pleistocene is assumed to have been about 25 m below the average sea level for that period. Sea level during the last glacial maximum (21–18 ka) briefly decreased to 130 m below present sea level.


Late Pleistocene
Low Stand
Mid-Late Holocene
High Stand
Columbia
River
Columbia
River
5100
5000
4900
4800
4700
Scale
100 km
Stonewall
Perpetua
Heceta
Banks
Low Stand
Depocenter
Stonewall
Perpetua
Heceta
Banks
Low Stand
Depocenter
KEY
Northward
Littoral Drift
Onshore Eolian
Transport
KEY
Onshore Wave
Transport
Longshore
Dispersal

Where did sand come from?

- Perhaps from the south, N. CA
- Climate models indicate much stronger northward winds at that time, therefore northward littoral transport
- Sand would have accumulated at Heceta Bank depocenter

References

Baker, D., C. Peterson, E. Hemphill-Haley, D. Twichell. 2010. Latest Pleistocene and Holoene (2-16 ka) sedimentation in the Columbia River Estuary, Oregon, USA. Marine Geology 273(1-4): 83-95.

Clemens, K.E. and Komar, P.d. 1988. Oregon beach-sand produced by the mixing of sediment under a transgressing sea. Journal of Sedimentary Petrology 58(3): 519-529.

Peterson, C.D. et al. 2007. Ages, distributions, and origins of upland coastal dune sheets in Oregon, USA. Geomorphology 91(1-2): 80-102.