

c15 Walther's principle < vertical and horizontal facies match >

The various deposits of the same facies-area and similarly the sum of the rocks of different facies-areas are formed beside each other in space, though in a cross section we see them lying on top of each other.

As with biotypes, it is a basic statement of far reaching significance that only those facies and facies-areas can be superimposed primarily which can be observed beside each other at the present time.

—Walther's law of correlation of facies (1894)¹
translated from the original German by G. Middleton in 1973.²

Accumulates that uniquely record an environment are called *facies*. From a coast seaward, warm-ocean continental shelf environments (and sedimentary rocks that record these) are typically: littoral (sandstone), below wave base (shale), and coral reef (limestone). During a transgression of the sea, offshore facies come to bury inshore facies. In the present case, a layer of limestone will spread to cover an older part of a layer of shale which will have spread to cover an older part of a layer of sandstone. Each layer is time transgressive as it was not deposited at one time but is deposited piecemeal during the time of the transgression. So the layer of sandstone will not have the same age everywhere and is oldest in that part of it that was deposited at the beginning of the transgression.

In practice, a geologist mapping ancient sediments will have no ready way of recognizing time horizons initially, and will usually map the (above) succession provisionally as a limestone formation overlying a shale formation overlying a sandstone formation. Pioneer geologists stopped there and assumed from the principle of superposition that the limestone recorded an evaporating epicontinental sea, the shale recorded an earlier time when the continent was deeply sunken (had foundered), and the sandstone layer was indicative of deposition at a prior time when the continent was emergent and was with marginal mountains undergoing erosion to produce the sand.

Careful search for time horizons has established the value of the principle that extensive formations are time transgressive. This realization caused a revolution in geology (beginning ca. 1840). The laurels for being the first to solve for geologists what later became termed Walter's Law (see below), are rightly to Amans Gressly (1814-1865). This Swiss geologist, in his memoir on the stratigraphy of younger Jurassic rocks of the Swiss Jura (1938-41) arrived at, what is, the modern definition of sedimentary facies, which is that each records a different environment of contemporaneous deposition, and came to the realization that the vertical and horizontal relations of facies must be compatible in terms of the environments that each represents. Some fifty years later, **Johannes Walther** (1860-1937) independently enunciated (1893-94) the same principle that *to a vertical progression of facies can be found corresponding lateral facies changes* ("Walther's Law") and the following understanding:



- Sedimentary rock types record the environment of their deposition.
- Depositional environments can shift laterally as conditions change.
- When so, laterally related environments become superimposed.
- Time-transgressive sedimentary formations, are the result.
- The vertical succession and lateral sequence of facies will be the same.

Using this principle, a vertical succession, encountered say as drill core is retrieved, of sandstone over shale over limestone, can be read as regression (offlap), and a vertical succession of limestone over shale over sand, can be read as transgression (onlap) of an epeiric (continental shelf and interior, shallow) sea (**Figure c15.1**). Walther had originally applied his principle for the correlation of facies to argue for the deepening of a transgressive

epeiric sea in Germany. When the same was applied, by American geologists, to platform sediments in North America, a revolution in understanding was to replace the “layer cake” reading of the formations with a time-transgressive reading of the same.

Walther's Law is pronounced as it reads. (In advertizing speak, its ‘speechstream visibility’ [will a consumer read the name properly?]) and its ‘phonetic transparency’ [is it spelled as it sounds?] makes it so—but perhaps, when a pedant says “Neandertal,” you should enquire about “Valter”).

Parasequences are sedimentary successions that sample lateral facies in accordance with Walther's Law.

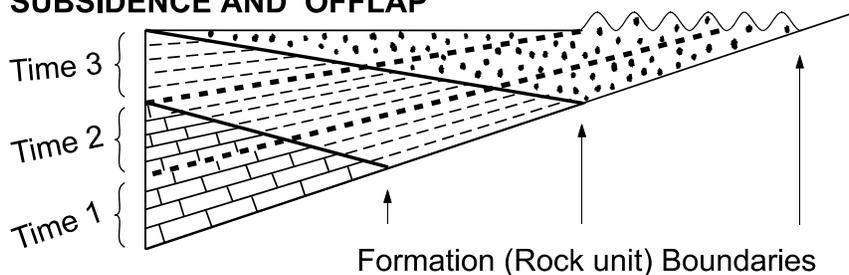
Caution

Climatic fluctuations, geologically rapid in their alternation, can result in a stratigraphic successions of superposed depositional facies that do not coexisted laterally. When so, Walther's Law, can have no application. For example, typical of upper Paleozoic strata in many parts of the world are cyclically deposited carbonate and siliciclastic facies with intracyclic stratigraphic features that indicate glacial to interglacial climatic shifts. Each such climate can reconfigure depositional environments, geologically abruptly, across an entire depositional region. Examples from the Upper Pennsylvanian basins of the southern Ancestral Rocky Mountains described by Gerilyn (Lynn) S. Soreghan, in 1997, are:³

- 1) cyclically deposited eolian/marine siltstone and subtidal/peritidal carbonate facies (with sharp contacts when traced vertically to bedding) in the northern Pedregosa basin, that exhibit an absence of facies mixing that indicate climatic control on silt influx.
- 2) cyclically deposited deltaic siliciclastic strata and subtidal/peritidal carbonate facies (with sharp contacts when traced vertically to bedding) in the western Orogrande basin, that exhibit an absence of facies mixing, truncated siliciclastic progradation, and carbonate facies with emergence features. □

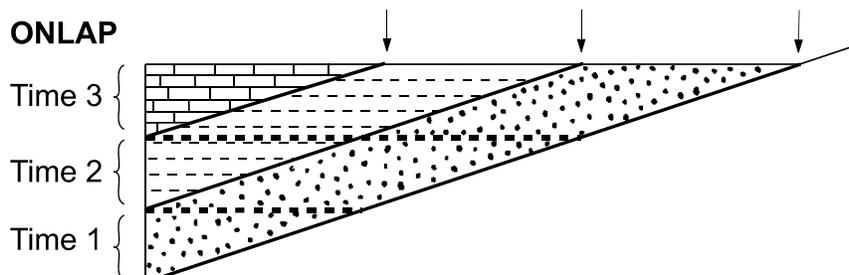
Figure c15.1 Idealized sections which show sedimentary facies laterally away from the land of sandstone (stipples), shale (dashes), and limestone (bricks). Formations of these facies are time transgressive in both offlap and onlap sequences. *Note:* Layering in the stylized rock symbols is drawn parallel to the time horizons (not the formation boundaries). This presumes the geologist who maps the formations can also establish the time horizons. However, the angle between formation boundaries and time horizons is very small in natural sections. (In these sections, for clarity, there is great vertical exaggeration.)

SUBSIDENCE AND OFFLAP



The offlap sequence geometry, when offlap is recorded by sediments and not just by an erosion surface (crenulated line), is not simple as there is subsidence also seaward of the shore.

ONLAP



The onlap sequence geometry, when onlap onto an incline is recorded by sediments can be as simple as is shown.