Supplementary Material 2: Illustrations of Facies

This appendix illustrates the variety of facies identified in this study, through a collection of pictures taken at the outcrops and thin-section microphotographies of samples collected from the carbonate units. For a detailed description of the facies, see Table 2 of the main text. The exact location of photographed intervals and thin-sectioned samples is reported in the stratigraphic logs of the measured sections in the main text.

Figure captions

Figure 1. Representative outcrop views of some of the identified facies. **A**) Facies Cg1, polymictic conglomerate (Cava Gosti). Note matrix-filled borings on pebbles (white arrows) and thin pebble coatings by coralline red algae (black arrows); **B**) Facies Cg1, polymictic, clast-supported conglomerate (Montefollonico): planar view of basal bedding surface. Note borings in some limestone pebbles (black arrows); **C**) Facies Cg2, basal breccia (Cava Gosti). Hammer for scale is 33 cm long; **D**) Facies Fg1, skeletal packstone forming a recessive bed (Casciana Terme). Note massive appearance and differences in cementation related to bioturbation. Bed is overlain by planar-stratified bottomsets of an *Amphistegina*-dominated clinoformed unit. Hammer for scale is 33 cm long; **E**) Facies Fg1, hybrid packstone, forming a recessive bed sandwiched between calcarenite deposits (facies Cal1 and Cal4) (Pavone Creek). Hammer for scale is 33 cm long; **F**) Facies Amph1, *Amphistegina* packstone to grainstone in foreset beds (Casciana Terme). Foreset beds at this outcrop display clear plane-parallel stratification. Hammer for scale is 33 cm long.

Figure 2. Representative outcrop views of some of the identified facies. **A**) Facies Amph1, *Amphistegina* grainstone to packstone in bioturbated foreset beds (Casciana Terme). Hammer for scale is 33 cm long; **B**) Facies Sh2, *Neopycnodonta* shellbed (Pavone Creek). Bed shown in cross-sectional view, with matrix between shells consisting of skeletal packstone to wackestone. Scale in cm; **C**) Facies Sh3, ostreid shellbed with calcarenite matrix (Poggio del Gallo). Photo shows underside of bedding plane, with several disarticulated valves oriented subhorizontally; **D**) Facies Sh3, pectinid shellbed (Poggio del Gallo). Note horizontal orientation of well-packed,

disarticulated valves of pectinids; **E**) Facies Sh4, *Isognomon* shellbed (Pianosa). Bed shown in cross-sectional view; **F**) Facies Alg1, maërl (Magliano).

Figure 3. Representative outcrop views of some of the identified facies. **A**) Facies Alg3, red-algae grainstone to rudstone in foreset beds (Magliano). Note the characteristic alternation of rudstone and grainstone layers and the openwork texture of the rudstone layer; **B**) Facies Ha1, well to moderately sorted hybrid arenite, showing low-angle to hummocky cross-stratification (Patrignone Creek); **C**) Facies Ha3, hybrid arenite in foreset beds, showing abundant *Thalassinoides* bioturbation (Magliano). Hammer for scale is 33 cm long; **D**) Facies Cal1, skeletal packstone (Pavone Creek). Note intense bioturbation of the calcarenite. Hammer for scale (encircled by white ellipse) is 33 cm long; **E**) Facies Cal2, skeletal packstone to grainstone in massive to bioturbated foreset beds (Pavone Creek). Angular termination of foresets on top of underlying calcarenite unit (facies Cal4) is marked by a dashed line. White arrow indicates a planar *Scolicia* bioturbation trace exposed on the underside of a foreset bed. Hammer for scale (encircled by white ellipse) is 33 cm long; **F**) Facies Cal4, skeletal grainstone to packstone showing moderately distinct bedding (Poggio del Gallo).

Figure 4. Thin-section microphotographs (in plane-parallel light) of samples representing some of the identified facies. **A**) Facies Fg1, fine-grained skeletal packstone forming a recessive bed (Casciana Terme, sample PL1D). Larger bioclast at bottom right is a serpulid fragment; **B**),**C**) Facies Amph1, *Amphistegina* packstone to grainstone in foreset beds (Casciana Terme, samples PL2N and PL2Q, respectively). Note preferential orientation of bioclasts parallel to the inclination of the foresets. Intergranular spaces are mostly filled by micrite, with secondary porosity due to loose matrix lost to weathering and dissolution; **D**) Facies Amph2, *Amphistegina* grainstone (Casciana Terme, sample PL2B). Note sparitic to microsparitic calcite cement filling intergranular spaces. Arrows point to other identifiable allochems (red algae = ra; echinoid = ec) beside *Amphistegina* tests; **E**) Facies Alg1, maërl (Roccastrada, sample RC2). Space between algal branches is filled by a hybrid skeletal packstone rich in very fine- to fine-sand-size siliciclastic granules; **F**) Facies Alg2, red algae grainstone (Poggio del Gallo, sample G15).

Arrows point to abrasion of algal fragments visible from erosional truncation of laminar thalli at the margins of the bioclasts.

Figure 5. Thin-section microphotographs (in plane-parallel light) of samples representing some of the identified facies. **A**) Facies Ha1, well to moderately sorted hybrid arenite (Patrignone Creek, sample MG1A). Arrows point to different types of bioclasts (red algae = ra; *Amphistegina* = am; mollusk = m; barnacle = br). Several medium- to coarse-sand-size subangular siliciclastic granules are also visible; **B**) Facies Ha2, massive to crudely bedded hybrid arenite (Bulera, sample BL9). Arrows indicate different types of bioclasts (red algae = ra; echinoid = ec; planktonic foraminifer = pf) and a larger lithic fragment (lf). Siliciclastic component includes a population of fine- to medium-sand-size, subangular quartz grains; **C**) Facies Ha3, hybrid arenite in foreset beds (Patrignone Creek, sample MG1H). Note preferential orientation of elongated clasts parallel to the inclination of the foresets; **D**) Facies Cal1, skeletal packstone (Montefollonico, sample G22); **E**) Facies Cal3, skeletal packstone to grainstone (Bulera, sample BL12). Note how left side of sample is richer in cement and right side in matrix. **F**) Facies Cal4, skeletal grainstone (Pavone Creek, sample SD13).

Facies Cal4

Facies Fg2

Facies Cal1

Facies Cal2

Facies Cal4

3 cm

3 cm

30 cm