**TEXT S-1:**

**Lithofacies description**

**Clotted peloidal mudstone/wackestone (FA1)**: it forms wavy, tabular, occasionally lenticular, centimetre thick beds locally organized in sets of mm thick laminae (**Fig. S8a, b,** **Fig. S3c**). Main components are represented by irregular to sub−rounded grains of clotted peloidal micrite with fenestral or lens-shaped voids and irregular voids up to 1 cm in size (locally inter-laminae) filled by limpid equant microsparite to sparite cement. Clotted peloidal micrite precipitation is attributed to microbial mats mediated via various organomineralic pathways of biologically induced and influenced mineralization (Reitner *et al.* 1995; Dupraz *et al.* 2009; Pedley *et al.* 2009). Generally, the FA1 facies relates to low-energy environments (such as ponds, palustrine or lacustrine shores) or gently inclined stream able to support the microbial activity (Guo and Riding 1998; Gandin and Capezzuoli 2014; Della Porta 2015).

**Crystalline dendrite boundstone (FA2):**generallydark grey to black tabular beds, locally lenticular or hemi-domic, up to several dm in thickness and variable in lateral extent (**Fig. S3k**). They are characterized by laminae (locally with sub-parallel growth lamina) formed by lateral juxtaposition of prismatic to lozenge-shaped calcite crystals (0.05−2 mm long), growing orthogonal to the depositional surface and turbid in appearance (**Fig. S8c**). Crystals are formed by elongated sub-crystals mainly in a feather-like arrangement (Koban and Schweigert 1993) and with undulose extinction and locally as fan-like (Guo and Riding 1992; Jones and Renaut 1995) often with uniform extinction. The porosity is very reduced, with sub-mm to mm-size inter-dendrite and inter-branching pores always filled by sparite cement. Sparitization with limpid blocky sparite replacement is locally present. The FA2 facies is very common in tufa and travertine depositional systems and common interpreted as rapidly precipitated by fast-flowing water at smooth to stepped slopes, and rims of pools as a result of CO2 degassing from carbonate-rich waters during their flow (Jones and Renaut 1995, 2010 for a review; Guo and Riding 1998; Jones *et al.* 2000; Gandin and Capezzuoli 2014; Alçiçek *et al.* 2017).

**Laminated boundstones (FA3)**: it is represented by wavy or hemidomic, locally tabular to highly inclined or lenticular beds (dm to cm in thickness) organized in set of mm/cm laminae formed by subparallel, discontinuous, alternated light micrite/microsparite wavy crusts (0,01−2 mm thick) and dark micritic peloidal or dominantly microsparitic laminae (**Fig. S8d; Fig. S4d-f**). Cyanobacterial molds and algal filaments are present. The FA3 facies is recorded in most of the studied locations, generally associated with coated plants. Porosity is generally inter-laminae and fenestral, horizontally well-connected and locally enhanced by dissolution. Macropores results filled with scalenohedral prismatic to equant calcite cements. Suitable environments for consortia of microbes mediate boundstone precipitation by providing sites for calcite nucleation and/or binding (e.g., Merz-Preiß and Riding 1999; Pentecost and Whitton 2000; Shiraishi *et al.* 2008; Pedley *et al.* 2009; Gradziñski 2010) according to different hydrological/chemical characteristics (Jones and Renaut 2010; Gandin and Capezzuoli 2014). The FA3 facies may have formed in stagnant pools or by fast-flowing waters in gently sloped, stepped channels (Arenas-Abad *et al.* 2010; Gradziñski *et al.* 2014) or, depending on facies association, it can represent standing waters in lacustrine/palustrine shores.

**Coated plants boundstones (FA4):**The FA4 facies, resembling to phytohermal framestone (Ford and Pedley 1996), or phytohermal limestones of stems (Arenas-Abad *et al.* 2010), is mainly formed by elongated, vertically oriented tubes (several cm long and 0.5–2 cm wide) of plants in growth position forming lenticular, occasionally domed or tabular beds, up to 1 m thick (**Fig. S3d-j; Fig. S4b-c; Fig. S5a-c; Fig. S6c-e**). Plants are decomposed and empty casts and molds are bounded with fine laminated, leiolitic, clotted peloidal micrite (**Fig. S8e**), or prismatic crystals carbonate coatings (0.2–5 mm thick). The dominant biomoldic porosity is filled with scalenohedral prismatic to equant calcite cements. The FA4 facies builds beds up to 40–60 m thick. The deposition of the FA4 facies results from slow-flowing streams or developed in palustrine areas and subsequent encrustation of accumulated plant detritus (Pedley 2009; Arenas-Abad *et al.* 2010). It is also reported from marginal areas of thermal springs (Guo and Riding 1998; Rainey and Jones 2009; Jones and Renaut 2010; Capezzuoli *et al.* 2014). Depending on facies association, this facies can represent interchannel areas or lacustrine shores.

**Intraclastic rudstones/packstones (FA5):**intraclasts are sub-rounded coated grains (pisoids, oncoids, mm to cm in diameter) formed mainly by different nuclei (phytoclasts, leaves, lithic fragments, peloids) enveloped by mm-thick outer cortices of micritic or radially arranged lozenge-shaped crystals coatings (**Fig. S8f; Fig. S3a-b**). Their outer surface is smooth and even polished. Elements are generally interbedded with fine-grained siltstone and organized in tabular-to-lenticular beds, up to dm in thickness and several m in lateral extent, showing horizontal, cross- and normal gradded-bedding. Porosity is always biomoldic and intra-particle. They occur in the form of high hillocks or mounds associated with laminated boundstones. Intraclasts commonly occur at the margin of low-energy continental carbonate depositional systems (dammed areas, pools, shallow lakes: Pedley 1990) or along active channels trapped for water-energy fall (Ordónez and García del Cura 1983; Guo and Riding 1998; Jones and Renaut 2010; Vázquez-Urbez *et al.* 2012; Gandin and Capezzuoli 2014; Nicoll and Sallam 2017).

**Micritic dendrite boundstones (FA6)**: local lenticular portions of laminated boundstones and/or clotted peloidal mudstone are formed by aggregation of branching dendrites (up to 1 cm) made of peloids and irregular micrite clots (**Fig. S8g**) locally surrounding elongated tubular sub-mm size cavities. Such cavities, as the sub-mm to mm-size inter-dendrite and inter-branching porosity locally present, result filled by microsparite. Locally filaments are also coated by microsparitic calcite (**Fig. S8h**). This facies association is also known as ‘bacterial shrubs’ (Chafetz and Folk 1984; Chafetz and Guidry 1999; Erthal *et al.* 2017) observed in travertines formed in ponds and low-energy depositional environments promoted by sulphide-oxidizing bacteria in H2S-rich thermal water (Guo and Riding 1998; Gandin and Capezzuoli 2014; Della Porta 2015), and also reported as ‘algal bushes’ from similar tufa depositional environments when clear evidences of organism (tubular cavities) are present (Monty 1976; Ordoñez and Garcia del Cura 1983; Love and Chafetz 1988; Pentecost 2005). Crystallographically, such dendritic forms also imply polycrystal nucleation, and thus a very rapid rate of precipitation (Bastianini *et al.* 2019).