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Artikel: Sedimentology of the Upper Marine Molasse of the Rhône-Alp region, eastern France : implications for basin evolution

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Kapitel: 2: Stratigraphy

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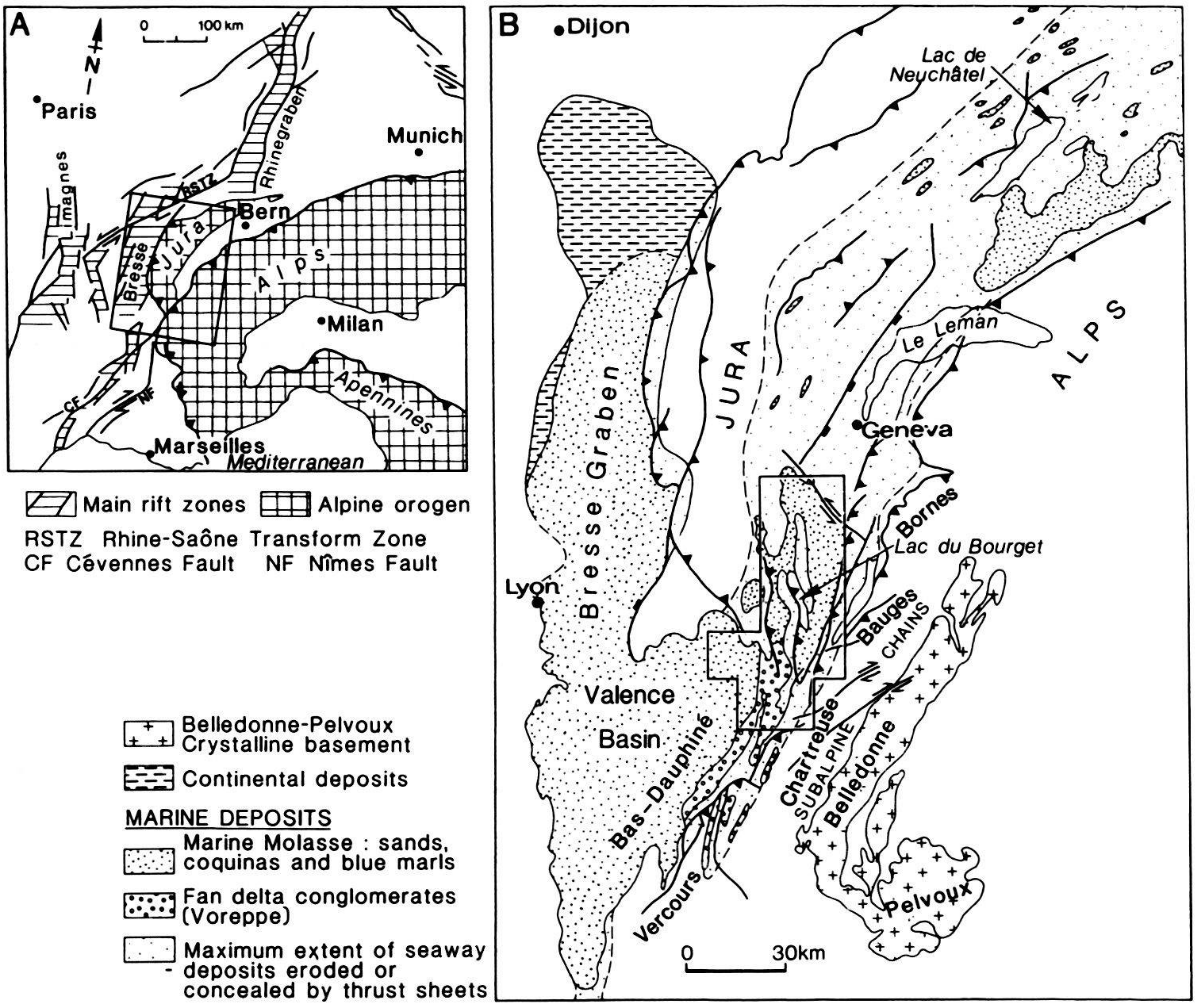

Fig. 1. **A** The western European rift system and Alpine orogenic belts (after Bergerat et al. 1990). **B** The Bresse-Rhone graben, Jura, Molasse Basin and Alpine arc in eastern France and Switzerland (after Debrand-Passard & Courbouleix 1984). The Belledonne-Pelvoux crystalline bsasement massif is shown for reference – other crystalline massifs are not shown.

area, dominated by the north-south aligned tight folds of the southern prolongation of the Jura, and the more strongly allochthonous units of the Subalpine chain (Santos-Narvaez 1980; Mugnier & Ménard 1986; Ménard 1988; Guellec et al. 1989, 1990; Butler 1989, 1991). The aim of this study was to provide a documentation of the marine facies present in the seaway and to make some palaeogeographical reconstructions for the Burdigalian-Serravallian time period. These data should prove useful in the future synthesis of the dynamics of the Miocene peri-Alpine seaway in France and Switzerland.

2. Stratigraphy

The rocks of the Rhône-Alp region range in age from Mesozoic to Miocene. The OMM was deposited during the time period represented by the Burdigalian, Langhian and Serravallian stages of the Miocene. These Miocene marine sediments have a sharp

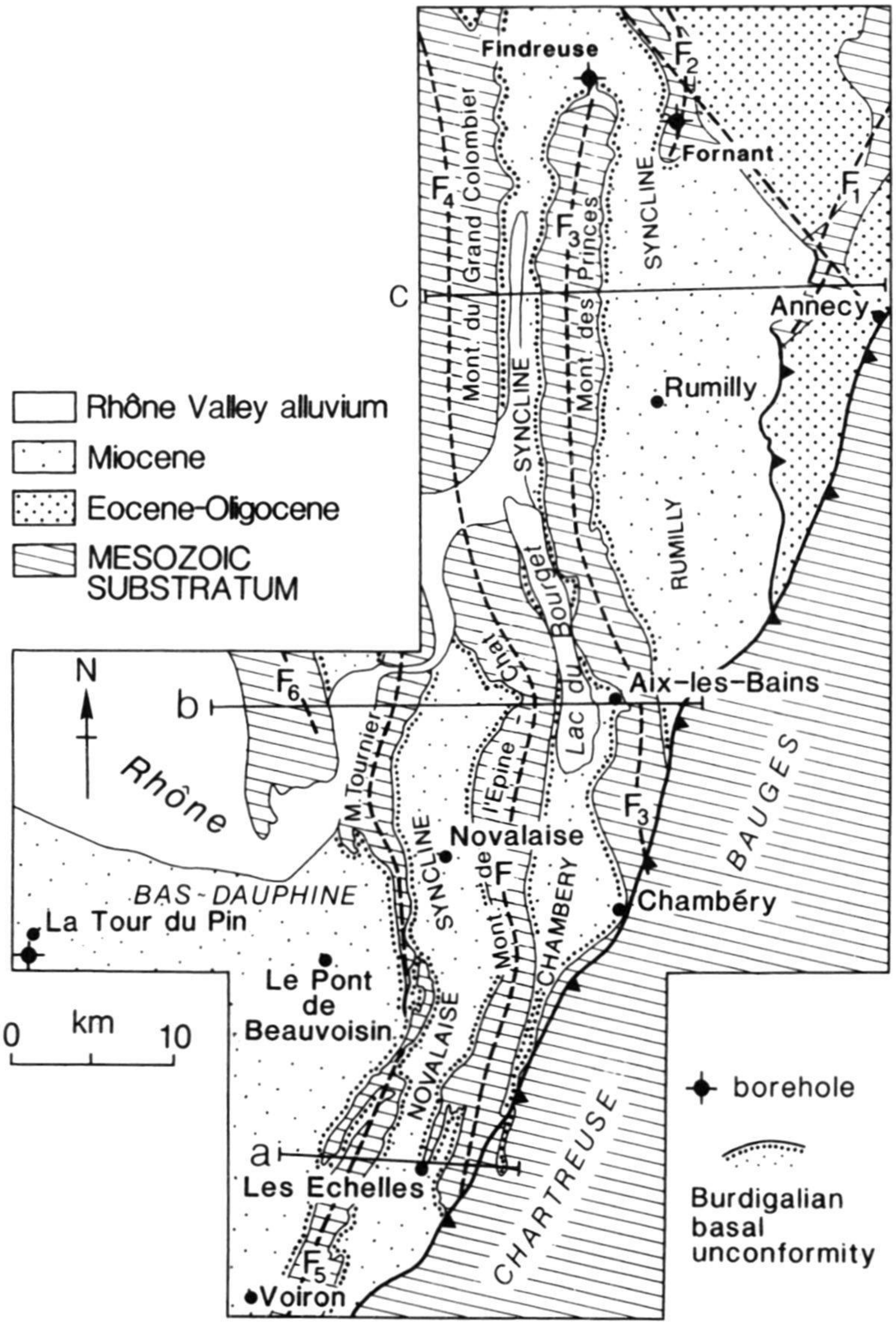

Fig. 2. Geological map of the Rhône-Alp region showing the N–S anticlines of Mesozoic rocks and adjacent synclines containing Molasse. Cross-sections a, b, c are shown in Figure 5. The locations of the boreholes at Fornant and Findreuse (Savoie) and close to La Tour du Pin (Bas-Dauphine) are shown.

boundary with underlying Lower Freshwater Molasse, as, for example in the north of the study area in the region of Rumilly and Seyssel, which has been dated as latest Aquitanian or basal Burdigalian using macrofossil and microfossil evidence cited in Berger (1985). The youngest Lower Freshwater Molasse directly beneath the OMM in the area of the two boreholes at Fornant and Findreuse (Fig. 2) has been dated using a magne-

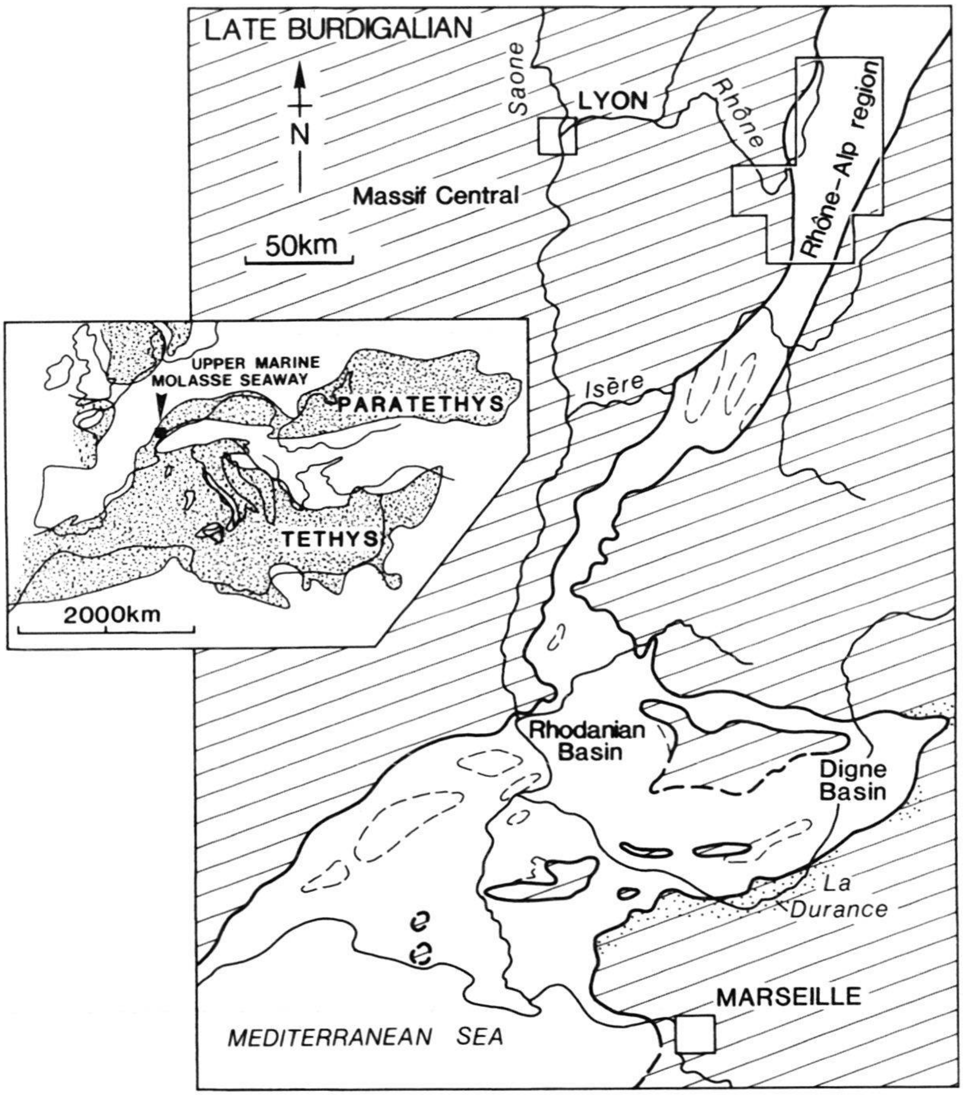

Fig. 3. The palaeogeographical reconstruction of the OMM seaway during the Burdigalian (compare with expanded seaway in Figure 1 B) (after Demarcq 1984). Eastern closure of Paratethys in inset is uncertain.

tostratigraphic chronology as < 21.5 Ma (Aquitanian) (Burbank, Engesser et al., 1992). The biostratigraphical assignment based on the Swiss mammal zones is from the La Chaux to Brüttelen 2 levels, as in the Mittelland of western Switzerland (Berger 1992). The base of the OMM is rarely dated from mammals. In western Switzerland, marine sediments already occur between the levels of La Chaux and Vully 1, that is, within the Aquitanian, so that no major stratigraphic gap between the Lower Freshwater Molasse and the Upper Marine Molasse is discernible in the plateau region of western Switzerland. In Savoie and the northern part of the Rhône-Alp region (Rumilly-Seyssel), the situation is a little less clear, but the base of the OMM may also be latest Aquitanian to early Burdigalian (Latreille 1969). This supports the view that little erosion has taken place at the boundary between the Lower Freshwater Molasse and the Upper Marine Molasse in the north of the study area. The basal OMM must have an age date close to 21 Ma. Elsewhere, particularly in the south of the Rhône-Alp study area, the OMM directly overlies Mesozoic strata with a large chronostratigraphic gap. In general, the biostratigraphical control *within* the OMM is very poor, though the top of the OMM can be dated by the first occurrence of planktic foraminifera such as *Orbulina universa* and *Orbulina suturalis*, demonstrating an age of N8 or younger (Langhian or Serravallian). Previous workers have been forced into making primarily a lithostratigraphical subdivision of the succession (Lamiraux 1977; Mujito 1981), dated where possible by poor microfaunal assemblages (Latreille 1969), or correlated loosely with similar lithological units outside of the region which have more reliable biostratigraphical assignments (Perriaux 1984).

The lithostratigraphical units defined by Lamiraux (1977) have, in places, interfingering relationships along their boundaries, so that parts of some units are age-equivalent to parts of other units. We therefore have built our stratigraphic framework on the basis of the work of Lamiraux (1977), differentiating five *lithosomes* – a term which Wheeler & Mallory (1956) used for "*a rock mass of essentially uniform or uniformly heterogeneous lithologic character, having intertonguing relationships in all directions with adjacent masses of different lithologic character*". The succession is well differentiated into these lithosomes in the southern half of the study area between Chambéry and the Bas-Dauphiné (Fig. 4), but the stratigraphy is less well differentiated towards the north of the area in Haute-Savoie. However, the Montaugier unit acts as a marker that is found throughout the region; it does not exhibit obvious interfingering relationships with other lithosomes.

3. Structure and Tectonic Setting

Closure of the Piemont/Tethyan ocean and collision of Adria and Europe (Tapponnier 1977) resulted in the shortening of the European margin and the downflexing of the European plate (Karner & Watts 1983; Mugnier & Ménard 1986; Homewood et al. 1986). The resulting foreland basin filled firstly with Eocene to lower Oligocene marine sediments typified by the North Helvetic Flysch of Switzerland and Haute Savoie (principally the Taveyannaz and Val d'Illiez Formations) and the Annot and Champsaur Formations of Haute Provence and les Hautes-Alpes. The basin then filled essentially to sea level during the Molasse phase (Oligocene to mid-Miocene). Telescoping of the European margin to the east of the study area in the Oligocene to late Miocene resulted in the deformation of these foreland basin sediments (principally the Eocene-early Oligocene flysch-like sediments and the Chattian-Aquitanian Lower Freshwater Molasse, together with, in the Chartreuse, the Burdigalian OMM).

Continued compression from the Alpine wedge since the end-Miocene caused folding of the Mesozoic substrate of the region together with its Tertiary cover, forming the NNE–SSW trending southern prolongation of the Folded Jura. The shortening accompanying this phase of deformation is, however, slight compared to the large displacements in the orogenic belt proper (Mugnier et al. 1987; Gratier et al. 1989). Section balancing indicates that the shortening across the Jura folds in the southern part of the study area is about 5%, with this value increasing progressively towards the north into the Jura fold-thrust belt (Chauve et al. 1988; Guellec et al. 1990). The western limbs of the Jura folds are commonly cut by steep thrust faults (Fig. 5). These may be older faults dating from the Rhine-Bresse-Rhône extensional phase that have been inverted, creating folds in their hangingwalls. The OMM is preserved in synclines between these Jura folds.