

Geology of the Alps

Revised and updated translation of *Geologie der Alpen*,
Second Edition

O. Adrian Pfiffner

WILEY Blackwell

Contents

Preface	viii
1 The Alps in their Plate Tectonic Framework	1
1.1 Older Mountain Chains in Europe	2
1.2 Break-up of Pangaea and Opening of the Alpine Tethys	8
1.3 The Alpine System in Europe	12
1.4 Structure of the Alps	14
References	20
2 The pre-Triassic Basement of the Alps	23
2.1 The pre-Triassic Basement in the Black Forest and Vosges	25
2.2 The pre-Triassic Basement of the External Massifs	29
External Massifs in the Western Alps	30
External Massifs in the Central Alps	32
External Massifs in the Eastern Alps	37
2.3 The pre-Triassic Basement of the Penninic Nappes	39
2.4 The pre-Triassic Basement of the Austroalpine Nappes	40
2.5 The pre-Triassic Basement of the Southern Alps	43
2.6 Palaeozoic Sediments in the Eastern and Southern Alps	49
The Palaeozoic in the Carnic Alps	49
The Palaeozoic of the Greywacke Zone	51
The Palaeozoic of the Innsbruck Quartz Phyllite	51
2.7 The Variscan Orogen at the Close of the Palaeozoic	54
2.8 Post-Variscan Sediments and Volcanics of the Permian	58
The North Swiss Permo-Carboniferous Trough	58
The Permo-Carboniferous in the Helvetic Nappe Complex	59
The Permo-Carboniferous in the Penninic Nappe Complex	62
The Permo-Carboniferous in the Austroalpine Nappe Complex	64
The Permo-Carboniferous in the Southalpine Nappe System	66
References	68
3 The Alpine Domain in the Mesozoic	71
3.1 The Mesozoic Rock Suites	72

The European Continental Margin.....	72
Oceanic Arms between the Baltic and Africa.....	81
The Adriatic Continental Margin.....	90
3.2 Plate Tectonic Evolution.....	95
Triassic: Epicontinental Platforms.....	95
Jurassic: Opening up of Oceanic Arms.....	97
Cretaceous: Opening and Closing of Oceanic Arms.....	116
References.....	125
4 The Alpine Domain in the Cenozoic.....	129
4.1 The Cenozoic Sedimentary Sequences.....	131
4.2 Late Cretaceous and Paleogene Flyschs.....	136
4.3 Eocene–Oligocene Flyschs.....	140
4.4 Oligocene–Miocene Molasse in the Northalpine Foreland Basin.....	143
4.5 Oligocene–Pliocene Sediments in the Po Basin.....	147
4.6 The Jura Mountains.....	148
4.7 Intramontane Basins.....	149
4.8 Plutonic and Volcanic Rocks.....	149
4.9 Tectonic and Palaeogeographical Evolution.....	154
References.....	165
5 Tectonic Structure of the Alps.....	169
5.1 The Western Alps.....	173
The Jura Mountains.....	178
The Subalpine Chains of the Dauphinois.....	179
The Penninic Nappes and their Contact with the Adriatic Continental Margin.....	186
5.2 The Central Alps.....	192
The Jura Mountains.....	200
The Molasse Basin.....	204
The Helvetic Nappe System.....	209
The Penninic Nappe System.....	231
The Austroalpine Nappe System.....	240
The Southalpine Nappe System.....	242
5.3 The Eastern Alps.....	245
The Molasse Basin.....	251

The Helvetic Nappe System	255
The Penninic Nappe System	257
The Austroalpine Nappe System	258
The Southalpine Nappe System and Dolomites	264
5.4 The Deep Structure of the Alps	265
References	275
6 Tectonic Evolution of the Alps	281
6.1 Alpine Metamorphism	283
Regional Distribution of Alpine Metamorphism	283
High-Pressure Metamorphism	286
Temperature-Dominated Regional Metamorphism	290
Contact Metamorphism	291
6.2 The Cretaceous Orogeny	294
6.3 The Cenozoic Orogeny	296
6.4 Uplift and Erosion	322
References	330
7 The Latest Steps in the Evolution of the Alps	335
7.1 Miocene and Pliocene Drainage Patterns	337
7.2 Pleistocene Glaciations	342
7.3 Recent Movements and Seismicity	348
7.4 Rockslides, Creeping Slopes, Erosion by Modern Rivers	355
References	364
Index	367