

Table of Contents

Summary.....	1
Zusammenfassung.....	3
Acknowledgments.....	6
Danksagung.....	7
Chapter 1.....	9
<i>Introduction</i>	9
Chapter 2.....	14
<i>Geological Framework</i>	14
2.1 The Lower Rhine Graben.....	17
2.1.1 Present-Day Deformation.....	18
2.1.2 Instrumental Seismicity.....	18
2.1.3 Historical Seismicity.....	20
2.1.4 Paleoseismicity.....	21
2.2 References.....	23
Chapter 3.....	27
<i>Using High-Resolution Digital Elevation Data to Detect Non-Seismic Overprint on Suspected Fault Scarps: Implications for Trench Site Selections</i>	27
3.1 Abstract.....	27
3.2 Introduction.....	29
3.3 LiDAR Analysis.....	34
3.4 Regional Setting.....	37
3.5 The Erft-Fault Area.....	39
3.6 The Wissersheimer-Fault Area.....	41
3.7 Results.....	42
3.7.1 Erft-Fault Area.....	42
3.7.2 Wissersheimer-Fault Area.....	46
3.8 Interpretation.....	50
3.9 Discussion.....	54
3.9.1 Suitability of the Study Areas for Trench Analysis.....	54
3.9.2 Bombturbation - A Disqualification Factor for Trenching?.....	54
3.9.3 LiDAR Analysis in Paleoseismology.....	56
3.10 Conclusions.....	57
3.11 References.....	58
Chapter 4.....	61
<i>Historical Coseismic Surface Rupture Identified in Intraplate Europe</i>	61
4.1 Abstract.....	61
4.2 Introduction.....	62
4.3 Results.....	65
4.4 Coseismic Rupture vs. Aseismic Creep.....	70
4.5 References.....	72
Chapter 5.....	74
<i>Paleoseismological Constraints on a Historically Active Intraplate Fault, Schafberg Fault, Lower Rhine Graben</i>	74
5.1 Abstract.....	74
5.2 Introduction.....	75
5.2.1 The 1756 Düren Earthquake.....	77
5.2.2 Regional Geological Setting.....	78
5.2.3 Tectonogeomorphic Setting of the Study Site.....	79
5.3 Methods.....	83

5.3.1 Trench Site Selection	83
5.3.2 Trenching Strategy	83
5.3.3 Mapping Strategy	84
5.4 Results	86
5.4.1 Trench Stratigraphy	86
5.4.2 Seismogenic Features	90
5.4.3 Ages of Event Horizons	93
5.5 Interpretation	96
5.5.1 Reconstruction of Coseismic Events	96
5.5.2 Resolution of Displacement	96
5.5.3 Robustness of Event Horizons	98
5.5.4 Recurrence Intervals	99
5.5.5 Complexity of the Fault Zone	99
5.6 Discussion	101
5.6.1 The Penultimate Event	101
5.6.2 Seismogenic Potential of the Schafberg Fault	101
5.6.3 Age of the Schafberg Fault	103
5.6.4 A Higher Holocene Slip Rate as a Response to Deglaciation?	104
5.6.5 Association with the 1756 Earthquake	105
5.6.6 Increased Seismic Activity in Central Europe after the 1755 Lisbon Earthquake?	105
5.6.7 Relevance of the Trench Location for Slip Rate Measures	108
5.6.8 Driving Mechanisms for Complex Deformation in Gravel	109
5.7 Conclusions	111
5.8 References	112
Chapter 6	116
<i>Fractured Clasts in Unconsolidated Gravels Record Coseismic Rupture</i>	116
6.1 Abstract	116
6.2 Introduction	117
6.3 Methods	121
6.4 Results	124
6.4.1 Clast Characteristics	124
6.4.2 Fault Zone Architecture	124
6.4.3 Fractures	126
6.5 Breakage Behaviour of Gravels	132
6.5.1 Clast Breakage under Various Loading Conditions	132
6.5.2 Impact Fracturing	133
6.6 Fracture Toughness of Clasts	134
6.7 Sources of Stress	136
6.7.1 Sediment Overburden	136
6.7.2 Slow Tectonic Deformation	136
6.7.3 Coseismic Deformation	137
6.8 Spatial Distribution of Different Fracture Types	138
6.9 Conclusions	140
6.10 References	141
Chapter 7	144
<i>Conclusions and Outlook</i>	144
Appendix	146
I. Trench Excavation Untermaubach	146
II. Trench Log and Radiocarbon Reports	148
III. Fractured-Clast Data	149
<i>Curriculum Vitae</i>	162