Appendices

A Abbreviations and symbols

Abbreviations

CCW	Critical Coulomb Wedge theory
EDM	Evolution of Deformation Map
ELA	Equilibrium Line Altitude
ISU	Incremental Surface Uplift
OOSD	Out-Of-Sequence Displacement index
PIV	Particle Image Velocimetry

Symbols related to CCW

x, y, z	Cartesian coordinates $[m]$
τ	Shear stress $[Pa]$
τ_b	Basal shear stress $[Pa]$
μ_0	Coefficient of internal friction
μ_b	Coefficient of basal friction
ϕ_0	Angle of internal friction $[^\circ]$
ϕ_b	Angle of basal friction $[^\circ]$
C	Cohesion $[Pa]$
σ_N	Normal stress $[Pa]$
p_f	Fluid pressure $[Pa]$
ρ	Density of wedge $[kg/m^3]$
g	Acceleration due to gravity $= 9.81\ [m/s^2]$
Hw	height of wedge $[m]$
ρ_w	Density of water $[kg/m^3]$
D	Height of the water column $[m]$
λ_0	Internal Hubbert and Rubey pore fluid ratio
λ_b	Basal Hubbert and Rubey pore fluid ratio
K	Push from the rear
α	Surface slope $[^\circ]$
β	Dip of the detachment $[^\circ]$
Ψ_0	Angle between σ_1 and the surface slope $[^\circ]$
Ψ_b	Angle between σ_1 and the detachment $[^\circ]$

Symbols related to the scaling of analogue experiments

S	Scaling factor
C	Cohesion of natural rocks $[Pa]$
ρ	Density of natural rocks $[kg/m^3]$
g	Acceleration due to gravity $= 9.81\ [m/s^2]$
C_M	Cohesion of analogue materials $[Pa]$
ρ_M	Density of analogue materials $[kg/m^3]$
a	Acceleration during analogue experiments $= 9.81\ [m/s^2]$

Symbols related to experiment analysis

H_0	Height of the undeformed multilayer [m]
H	Height above the singularity [m]
L_{fp}	Horizontal distance between the deformation front of frontal accretion and the singularity [m]
L_{bp}	Horizontal distance between the deformation front of basal accretion and the singularity [m]
L_r	Horizontal distance between the deformation front of the retro-wedge and the singularity [m]
U	Uplift [m]
E	Erosion [m]
D	Length of a thrust [m]
e_{xy}	Horizontal shear strain [%]
s_{fw}	Sample standard deviation of wavelength of frontal accretion
s_{fs}	Sample standard deviation of spacing of frontal accretion
s_{bw}	Sample standard deviation of wavelength of basal accretion

Symbols related to the calculation of flexure

V_0	Vertical load of orogen [N]
W	Width of the hypothetical orogen $= 1$ [m]
L	Converted length of the pro-wedge [m]
H_c	Converted height of the axial-zone above the singularity [m]
α	Flexural parameter [m]
D	Flexural rigidity of the plate [Nm]
g	Acceleration due to gravity $= 9.81$ [m/s^2]
ρ_{orogen}	Density of a hypothetical orogen [kg/m^3]
ρ_{sed}	Density of sediments with which the foredeep is filled with [kg/m^3]
w_0	Deflection of plate at $x = 0$ [m]

B Supplementary data on DVD

Experiment 9.05:	9.05 basis.avi 9.05 v_x.avi 9.05 v_y.avi 9.05 e_{xy}.avi
Experiment 9.06:	9.06 basis.avi 9.06 v_x.avi 9.06 v_y.avi 9.06 e_{xy}.avi
Experiment 9.09:	9.09 basis.avi 9.09 v_x.avi 9.09 v_y.avi 9.09 e_{xy}.avi
Experiment 9.10:	9.10 basis.avi 9.10 v_x.avi 9.10 v_y.avi 9.10 e_{xy}.avi
Experiment 9.11:	9.11 basis.avi 9.11 v_x.avi 9.11 v_y.avi 9.11 e_{xy}.avi
Experiment 9.15:	9.15 basis.avi 9.15 v_x.avi 9.15 v_y.avi 9.15 e_{xy}.avi
Experiment 9.20:	9.20 basis.avi 9.20 v_x.avi 9.20 v_y.avi 9.20 e_{xy}.avi
Experiment 9.25:	9.25 basis.avi 9.25 v_x.avi 9.25 v_y.avi 9.25 e_{xy}.avi
Experiment 9.35:	9.35 basis.avi 9.35 v_x.avi 9.35 v_y.avi 9.35 e_{xy}.avi

C Technical specifications of tested springs

Number of spring	Diameter of wire [mm]	Mean diameter of spring [mm]	External diameter of spring [mm]	F_{Nmax} [N]
KM 3315	1.6	20.0	21.6	57.25
KM 3349	1.8	18.2	20.0	101.60
KM 3375	2	19.0	21.0	84.16
KM 3415	2.5	20.0	22.5	200.70
KM 3447	3.0	19.8	22.8	407.60
KM 3465	3.2	20.0	23.2	442.20

Table C.1: Technical specifications of tested springs.

D List of experiments

Test-experiments Group A

Material	Sand: S30T 1^{st} charge, $20-630\,\mu m$ Glass beads: $300-400\,\mu m$ Sandpaper: $< 400\,\mu m$
Setup	No flexure, thickness of lower (upper) plate 5 (10) cm, position of glass-bead layer in lower (upper) plate at 2.5 (5) cm
Documentation	Photos at every $10\,cm$ of convergence, video

Experiment	Location of erosion	Mode of erosion*
4.06	∅	∅
4.07	pro-wedge	distributed
4.08	retro-wedge	distributed

* Erosion was simulated after $40\,cm$ of convergence, at every $10\,cm$ of convergence (see section 4.2).

Table D.1: Test-experiments Group A

Test-experiments Group B

Material	Sand: S30T 2^{nd} charge, $20-630\,\mu m$ Glass beads: $300-400\,\mu m$ Sandpaper: $< 400\,\mu m$
Setup	Flexure (spring KM3415 [4 in text])
Documentation	Photos at every $10\,cm$ of convergence, video

Experiment	Distance spring - free end [cm]	Thickness of lower/upper plate [cm]	Thicknessratio lower : upper sand unit*
9.01	44	3/10	1 : 1
9.02	44	6/6	1 : 1
9.03	44	6/6	1 : 2
9.04†	30	6/6	1 : 2

* Lower sand unit is located beneath, upper sand unit is located above the glass-bead layer.
† No photographic documentation.

Table D.2: Test-experiments Group B

1^{st} experimental series

Material	Sand: S30T 2^{nd} charge, $20-630\,\mu m$ Glass beads: $300-400\,\mu m$ Sandpaper: $< 400\,\mu m$
Setup	Flexure (spring KM3415 [4 in text] $30\,cm$ from free end) No change of the mechanic stratigraphy across the singularity. An additional glass-bead layer is located between upper plate base and sand. Thickness of the sand layer $6\,cm$.
Documentation	Photos at every $10\,cm$ of convergence, video, PIV

Experiment	Flexure	Number of detachments	Height of detachment layer(s) above conveyor belt [cm]
9.05	✓	1	2
9.15	✓	0	∅
9.20	✓	2	2 and 4
9.25	∅	1	2
9.35*	✓	0	∅

* Upper plate consists of mortar.

Table D.3: Kinematic boundary conditions of 1^{st} experimental series.

2^{nd} experimental series

Material	Sand: S30T 2^{nd} charge, $20-630\,\mu m$ Glass beads: $300-400\,\mu m$ Sandpaper: $< 400\,\mu m$
Setup	Flexure (spring KM3415 [4 in text] $30\,cm$ from free end) Mechanic stratigraphy is the same as in experiment 9.05, which is used as reference. An additional glass-bead layer is located between upper plate base and sand.
Documentation	Photos at every $10\,cm$ of convergence, video, PIV

Experiment	Location of erosion	Mode of erosion*
9.05†	∅	∅
9.06	retro-wedge	distributed
9.07	pro-wedge	§
9.08	retro-wedge	distributed‡
9.09	pro-wedge	distributed
9.10	pro-wedge	focused
9.11	retro-wedge	focused

* See section 4.2 for further description. Erosion was simulated after 40 cm of convergence, at every 10 cm of convergence.
† Reference experiment.
§ Maximum erosion (distributed) of 1 cm per 10 cm of convergence at the toe of the pro-wedge.
‡ Maximum erosion 2 cm was simulated at every 20 cm convergence.

Table D.4: Kinematic boundary conditions of 2^{nd} experimental series.

3^{rd} experimental series

Material	Sand: S30T 2^{nd} charge, $20-630\,\mu m$ Glass beads: $300-400\,\mu m$ Sandpaper: $< 400\,\mu m$
Setup	Flexure (spring KM3415 [4 in text] 30 cm from free end) Mechanic stratigraphy is the same as in experiment 9.05, which is used as reference. An additional glass-bead layer is located between upper plate base and sand.
Documentation	Photos at every 10 cm of convergence, video, PIV

Experiment	Mode of erosion*	Maximum erosion of pro-/retro-wedge [cm]†
9.12	distributed	0.5/1
9.16	focused	0.5/1
9.17	distributed	1/0.5
9.18	focused	1/0.5

* See section 4.2 for further description. Erosion was simulated after 40 cm of convergence.
† Per 10 cm convergence.

Table D.5: Kinematic boundary conditions of 3^{rd} experimental series.

4^{th} experimental series

Material	Sand: S30T 2^{nd} charge, $20-630\,\mu m$ Glass beads: $300-400\,\mu m$ Sandpaper: $< 400\,\mu m$
Setup	Flexure (spring KM3415 [4 in text] $30\,cm$ from free end) Mechanic stratigraphy is the same as in experiment 9.05, which is used as reference. An additional glass-bead layer is located between upper plate base and sand.
Documentation	Photos at every $10\,cm$ of convergence, video, PIV

Experiment	Mode of erosion*	Location of erosion	Maximum erosion [cm]†
9.21	distributed	retro-wedge	0.5
9.22	distributed	retro-wedge	2

* See section 4.2 for further description. Erosion was simulated after $40\,cm$ of convergence.
† Per $10\,cm$ convergence.

Table D.6: Kinematic boundary conditions of 4^{th} experimental series.

5^{th} experimental series - Cascadia (Conducted by Dirk Scherler and Silvan Hoth)

Material	Sand: S30T 2^{nd} charge, $20-630\,\mu m$ Glass beads: $300-400\,\mu m$ Sandpaper: $< 400\,\mu m$
Setup	Flexure (spring KM3415 [4 in text] $30\,cm$ from free end) No change of the mechanic stratigraphy across the singularity, except a glass-bead layer between upper plate base and sand. Exp. 9.23. Mechanic stratigraphy is the same as in experiment 9.15. Exp. 9.24. Incoming layer consists of $3\,cm$ sand, upper plate is made up of mortar, which also covers the first $70\,cm$ of the lower plate.
Erosion	Exp. 9.23. Erosion pattern resembles the one observed in Cascadia. Erosion was simulated at every $10\,cm$ of convergence, after $100\,cm$ of initial convergence. Exp. 9.24. Erosion pattern resembles the one observed in Cascadia. Erosion was simulated at every $20\,cm$ of convergence, after $290\,cm$ of initial convergence.
Documentation	Photos at every $10\,cm$ of convergence, video, PIV

Curriculum vitae

Name:	Silvan Hoth
Born:	3. September 1974, Schwedt an der Oder
Citizenship:	German

School

1981 – 1989	Polytechnische Oberschule Neubrandenburg, Germany
1989 – 1990	Erweiterte Oberschule Neubrandenburg, Germany
1990 – 1994	Gymnasium Großburgwedel, Germany Degree: Abitur

University

1995 – 1999	Freiberg University of Mining and Technology, Germany
1999 – 2000	Royal Holloway and Bedford New College, University of London, UK Degree: Master of Science in Basin evolution and Dynamics Master Thesis (Royal Holloway, Freiberg): *Structural and sedimentological evolution of Block 53/10 South Hewett Basin during the Upper Rotliegend II. A seismic attribute approach.*
1998 – 2000	Scholarship of Studienstiftung des deutschen Volkes

Research

2001 – 2005	Research Assistant at GFZ Potsdam, Germany; Section 3.1 »Lithosphere Dynamics« (Prof. Onno Oncken)