Data Repository Item 2006088

Table DR1 : Age of the Tertiary lithostratigraphic units inferred from magnetostratigraphic studies and others methods

Name on Fig. 1			*Sa*	*Kn*	*Jw*	*Ci*	*Ku*	*Sw*	*Ka*	*Su*	*Ti-Ar*	*Bk*
Section		Chinji	Samba-Mansar	Kangra	Jawa	Chimnum	Kumahatti-Nahan highway	Swat area	Karnali	Surai	Tinau-Arung area	Bakaiya-Rato area
Reference	Lyon-Caen and Molnar, 1985	Burbank et al., 1996	Burbank et al., 1996	Brozovic and Burbank, 2000	Brozovic and Burbank, 2000	Najman et al., 2004	Najman et al., 2004 *****	****	Gautam and Fujiwara, 2000	Gautam and Rosler, 1999	Gautam and Rosler, 1999	Gautam and Rosler, 1999
Base pre-Siw.***	30					20,5*	<30 (27)	26				
Base up. Group pre-siw.		18				17	17					
Base Lower Siw.	15	14		11,2*	12,3*	12,8	**	**	15,8	13*	14*	11,5*
Base middle Siw.	11	11	10*	10,5	10,9	**	**	**	9,5	9,8	9,2	7,8
Base upper Siw.	5	8	6	6,8	7,2	**	**	**	3,9	5,2	3,8	3,1
Top of section	0		0,8	6,8	4,8	12,3	14	15	1,8	1,8	1,2	2

*Base truncated; ** Unit absent; *** base pre-Siw. or undifferentiated pre.Siw.; ****top of the section from Ojha, personnal communication; base from detrical thermal cooling data (Sakai et al., 1999); ***** detrital thermal cooling data (27 Ma assuming a lag time of 3 My for zircon dating (Bernet, personnal communic.).

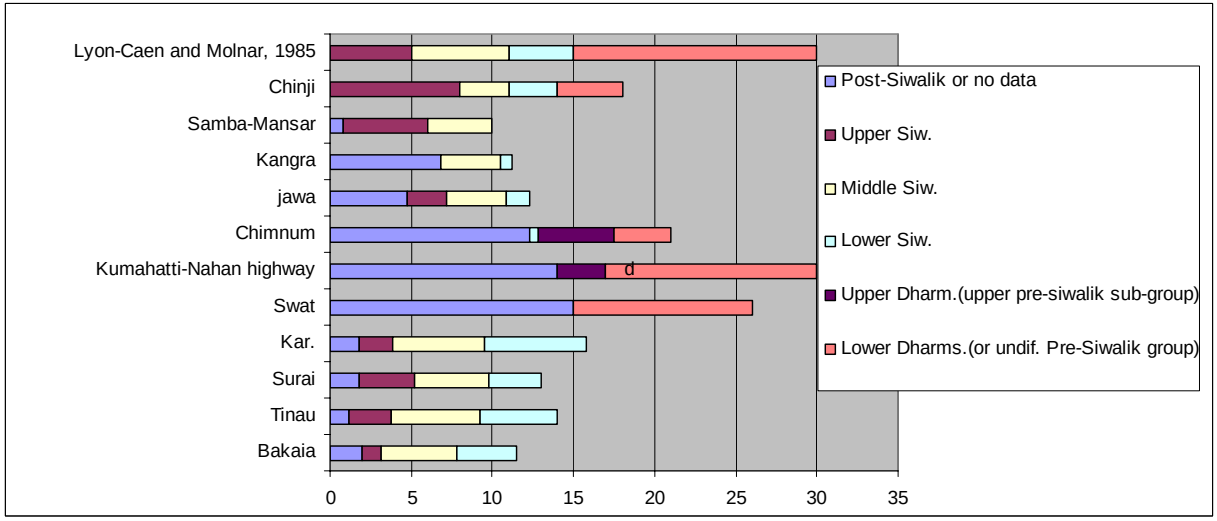

Table DR2 : The migration of the pinch-out of the Tertiary basin

Column 1- Locations are indicated from West to East on Fig.1. (* refers to pinch-out located above a tertiary unconformity).
Column 2- Full name of the drill-hole or location of the outcrop.
Column 3- Present day distance from the drill-hole to the southern edge of the basin measured on a 1/ 2 500 000 scale topographic map, with the south edge line of the basin represented on Fig. 1.
Column 4 and 5- Displacement towards the south of the thrust sheets estimated from balanced cross-section for the drill-holes of the sub-Himalayan zone and the outcrops of the Lesser Himalaya (Reference on column 5). **P** for drill-holes in the plain (no motion) and **F** for drill-holes that reach the footwall of the thrust system (no motion).
Column 6- Restore distance is the sum of present-day distance and displacement of the thrust sheets.
Column 7- Pinch-out distance error: this error is the sum of the uncertainty (5km) on the present-day position of the drill hole and of the cross-section restoration procedure error. The uncertainty about the present-day position of the southern margin of the basin is also indicated on the first line. We choose to present the error this way because the comparison between two drill-holes on the same cross-section of the basin is not affected by this major uncertainty.
Column 8 and 9- Thickness of the lowermost Tertiary lithostratigraphic unit in the drill-hole and origin of the data.
Column 10- Thickness of the nearest entire section (top and bottom boundary defined) of the lowermost Tertiary lithostratigraphic unit of the considered drill-hole.
Column 11- Nearest magnetostratigraphic studies (name in column 11, age from data repository 1 and location from Fig. 1) used to estimate the age of the Siwalik units boundary.
Column 12- The sedimentation rate is calculated from the thickness of the nearest complete section of the unit (column10) and from the age of the lithostratigraphic boundaries of the nearest magnetostratigraphic section (column 11). (Usually column 10 and 11 are the same).
Column 13- The age of the bottom of the tertiary sediments has been estimated assuming a constant sedimentation rate (column 12) for the deposition of the lowermost unit (column 8):

$$\text{Age bottom} = \text{age top of the lowermost unit in the nearest magnetostratigraphic study} + \frac{\text{thickness of the lowermost unit in the drill hole}}{\text{sedimentation rate for this unit estimated in a close section}}$$

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Column 14- Time error (My). The incertainty is calculated as the sum of the uncertainty on 1) the age of the top of the lowermost unit and 2) the uncertainty on the ratio thickness / sedimentation rate.

1) The uncertainty on the age of the top of the lowermost unit is due to the error on the age estimate and to the diachronism of facies change. The error on the age estimate of the error in the paleomagnetic studies will be considered in the order of 0.5 Ma. For the base of the pre-siwalik, the uncertainty is greater, in the order of 2 Ma. The total error due to the diachronism is the sum of the diachronism transversal to the chain and the "local" diachronism due to basin evolution parallel to the chain. Local diachronism is in the order of 2 Ma (Brozovic and Burbank, 2000). Assuming that we use a facies change as a time line in a cylindrical model of foreland basin, it is found that diachronism transversal to the chain is proportional to the distance and time is always over-estimated. We consider that the maximum error would be 5 Ma for the whole width of the basin and evolves linearly:

$$\Delta t_{\min us} = \frac{5Ma}{ba \sin width} \Delta x + 2Ma + 0.5Ma$$, with Δx the distance between the drill-hole and the reference section

2) The uncertainty on the ratio thickness/sedimentation is mainly due to the estimate of the sedimentation rate. Assuming that the subsidence of the basin is controlled by a steady-state flexure, sedimentation rate is over-estimated, and the age is under-estimated. Taking into account the small angle approximation and assuming that the slope of the flexed lithosphere could vary from 2° to 4°, the maximum error on the sedimentation rate is 50%. Assuming that the error increases linearly, it is found that $\Delta t_{plus} = \frac{50\%}{ba \sin width} \times \frac{Thickness}{sedrate} \times \Delta x + 2Ma + 0.5Ma$

Column 15- The pinch-out migration rate is estimated in cross-sections perpendicular to the structural trend of Himalaya by dividing the distance between the drill-holes and the present-day south boundary of the basin (column 6) by the age of the sediments at the bottom of the foreland basin (column 13) .

1	2	3	4	5	6	7	8	9	10	11	12	13	14		15
Ref. on Fig.1	Full name	Present day distance from edge	Displacement (km)	Origin of the shortening	Restore pinch-out distance (km)	Pinch-out distance error (km)	Thickness of the Lithostratigraphic units at the base	Origin of the log	Thickness of the lithostratigraphic unit in a reference section	Reference section for the age	Sedimentation rate of the basal lithostratigraphic unit in the reference section (m/My)	Estimated Age of the base of Tertiary sediments (Ma)	Time error (My) +	-	Migration rate (km/My)
Sm	Southern margin	0	P	-	0	50						0	0,0	0,0	0
Su	Suruinsar	201	6	Personal balancing of Srinivasan and Khar, 1996, Fig. 20A	207	10	2280 m lower Dharm.	Acharyya and Ray, 1982	600 m (Chimnum)	Chimnum	200	28	4,0	4,0	**7**

Zi	Zira	55	P	-	55	5	280 m middle Siw.	Lyon-Caen and Molnar, 1985 (from Karunakan and Rao, 1979; Sastri, 1979)	1190 m (Samba-Mansar)	Samba-Mansar	298	7	2,8	5,2	**8**
Ad	Adampur	132	P	-	132	5	120 m lower Siw.	Lyon-Caen and Molnar, 1985 (from Karunakan and Rao, 1979; Sastri, 1979)	500m (Kangra)	Kangra	523	11	2,5	3,1	**12**
Nu	Nurpur	201	7	Personnal balancing of Raiverman et al., 1994 Fig.5	208	10	860 m lower Dharm.	Srinivasan and Khar, 1996	600 m (Chimnum)	Chimnum	200	21	4,0	4,0	**10**
Ho	Hosiarpur	155	P	-	155	5	750 m lower Siw.	Srinivasan and Khar, 1996; Powers et al., 1998	550 m (Jawa)	Jawa	483	12	2,5	2,6	**13**
Jn2	Janauri 2	175	F	Powers et al., 1998	175	5	760m upper Dharm.	Powers et al., 1998 (Also Mukhopadhyay and Mishra, 1999)	1380 m (Chimnum)	Chimnum	329	15	2,8	4,0	**12**
Bh	Bahl	204	10	Powers et al., 1998	214	10	1210 m lower Dharm.		600 m (Chimnum)	Chimnum	200	23	4,0	4,0	**9**
Jw-B	Jawalamukhi (JMI-B)	214	10	Powers et al., 1998	224	10	2350 m lower Dharm.	Srinivasan and Khar, 1996	600 m (Chimnum)	Chimnum	200	28	3,0	3,0	**8**
Jw	Jawalamukhi	211	10	Powers et al., 1998	221	10	950 m lower Darhm.	Powers et al., 1998	600 m (Chimnum)	Chimnum	200	22	4,0	4,0	**10**
Ch	Changar Talai	198	15	Mishra, 2001	213	10	710 m lower Dharm.	Srinivasan and Khar, 1996	600 m (Chimnum)	Chimnum	200	21	4,0	4,0	**10**
Rm	Ramsahar	202	38	Mishra, 2001	240	15	base lower Dharm.(Dagshai)	Acharyya and Ray, 1982	no thickness	Kumahatti-Nahan	-	27	4,0	4,0	**9**
Ha	Haritalyangar (outcrop)	188	4	Mishra, 2001	192	10	base lower Siw. (unconf.)	Pascoe, 1964	no thickness	Chimnum	-	13	2,5	2,5	**15**
Sa	Saharanpur	154	P	-	154	5	400 m lower Siw.	Srinivasan and Khar, 1996	550 m (Jawa)	Jawa	483	12	2,5	2,4	**13**
Mh*	Mohand (Base Siw)	214	F	Powers et al., 1998	214	5	800 m lower Siw.	Raiverman et al., 1994; Bhatnagar, 1994; Powers et al., 1998	550 m (Jawa)	Jawa	483	12	2,4	2,5	**17**
Mh	Mohand (Base tertiary)	214	F	Powers et al., 1998	214	5	153 m lower Dharm.	Raiverman et al., 1994; Bhatnagar, 1994; Powers et al., 1998	600 m (Chimnum)	Chimnum	200	18	4,0	4,0	**12**
Li	Liskot (Less.	238	52	Srivastava	290	18	base lower	Srinivasan and	No thickness	Swat area	-	28	4,0	4,0	**10**

	Him. outcrop)			and Mitra, 1994			Dharm. (Dumri)	Khar, 1996; Valdiya, 1980		+ Kumahatti-Nahan					
Ka	Kasganj	83	P	-	83	5	250 m middle Siw.	Lyon-Caen and Molnar, 1985 (From Karunakan and Rao, 1979; Sastri, 1979)	1450 m (Puranpur)	Karnali	259	5	2.8	4,7	**17**
Uj	Ujhani	112	P	-	112	5	500 middle Siw.	Srinivasan and Khar, 1996	1450m (Puranpur)	Karnali	259	6	2,9	3,8	**19**
Ti	Tihar	155	P	-	155	5	1090 m middle Siw.	Lyon-Caen and Molnar, 1985 (From Karunakan and Rao, 1979; Sastri, 1979)	1450 m (Puranpur)	Karnali	259	8	3,0	3,6	**15**
Sh	Shahjahanpur	161	P	-	161	5	300m lower Siw.	Srinivasan and Khar, 1996	2000 m (Karnali)	Karnali	317	10	2,6	3,5	**15**
Pu*	Puranpur-2 (Base Siw)	227	P	-	227	5	470 m lower Siw.	Srinivasan and Khar, 1996; Bhatnagar, 1994	2000 m (Karnali)	Karnali	317	11	2,5	2,3	**21**
Pu	Puranpur-2 (Base tertiary)	227	P	-	227	5	180 m Dharm. below unconf.	Srinivasan and Khar, 1996; Bhatnagar, 1994	1000 m (Swat)	Swat	238	17	2,5	2,3	**14**
Kl	Karnali (Less. Him. Outcrop)	301	40	Mugnier et al., 2004	341	18	base lower Dharm. (Dumri)	Sakai et al., 1999	No thickness	Swat area	-	26	4,0	4,0	**13**
Mo	Motera	195	P		195	5	1300 m lower Siw.	Srinivasan and Khar, 1996	1350 m (Surai)	Surai	422	13	2,7	3,1	**15**
Rp	Rapti (Less. Him. Outcrop)	306	55	Mugnier et al., 2004	361	18	base lower Dharm. (Dumri)	Sakai et al., 1999	No thickness	Swat area	-	26	4,0	4,0	**14**
Ga	Gandak	248	P	-	248	5	2000 m lower Siw.	Srinivasan and Khar, 1996	2000m (Arung)	Arung	417	14	2,5	2,5	**18**
Gn	Ganauli	258	P	-	258	5	1410 m lower Siw.	Shukla and Chakravorty, 1994; Bhatnagar, 1994	2000 m (Arung)	Arung	417	13	2,5	2,5	**20**
Kd	Kadmaha	266	P	-	266	5	1150 m lower Siw.	Shukla and Chakravorty, 1994	2000 m (Arung)	Arung	417	12	2,5	2,4	**22**
Ra	Raxaul	220	P	-	220	5	1200 m lower Siw.	Srinivasan and Khar, 1996	2000 m (Arung)	Arung	417	12	2,7	3,1	**18**
Ma	Madghubani	192	P	-	192	5	850 m lower Siw.	Srinivasan and Khar, 1996	1400 m (Bakaia)	Bakaia	378	10	2,8	3,7	**19**
Ba	Bagmati (Pre-terti. outcrop)	246	18	Lavé and Avouac, 2000	264	15	1600 m lower Siw.	Shresta and Sharma, 1996	1400 m (Bakaia)	Bakaia	378	12	2,4	2,6	**22**

Pr	Purnea	161	P	-	161	5	950 m middle Siw.	Srinivasan and Khar, 1996	1350 m (Bakaia+Rato)	Bak.+ Rato	287	7	2,9	3,9	**24**
Bi	Biratnagar	170	P	-	170	5	3300 m Siw.	Bashyal, 1998	4600 m (Bakaia+Rato)	Bak.+ Rato	400	8	3,4	3,6	**21**
Fig2A	Pinch-out middle 2 Siw.	44	P	-	44	5	base upper Siw.	Shukla and Chakravorty, 1994		Karnali		4	2,5	2,5	**11**
Fig2A	Pinch-out middle 1 Siw.	160	P	-	160	5	base middle1 Siw.	Raiverman et al., 1994		Karnali		7	2,5	2,5	**24**
Fig2A	Pinch-out lower Siw.	185	P	-	185	5	base middle Siw.	Raiverman et al., 1994		Karnali		10	2,5	2,5	**19**
Fig2A	.Pinch-out highest Daharmsala (no erosion)	270	P	-	270	5	base lower Siw.	Raiverman et al., 1994		Swat and Karnali		15	2,5	2,5	**18**
Fig2A	Present-day leading edge Upper Dharm (erosion)	248	P	-	248	5	345 m upper Dharm. (estimation of the erosion)	Raiverman et al., 1994	1000 m (Swat)	Swat	238	17	2,5	2,5	**15**
Fig2A	Present-day leading edge lower Dharm (erosion)	224	P	-	224	5	300 m Lower Dharm. (estimation of the erosion)	Raiverman et al., 1994	1000 m (Swat)	Swat	238	18	2,5	2,5	**12**

Table DR3: Shortening rate estimate through the central Himalaya

Location	Method	Reference	Age (Ma)	Total shortening (km)	Shortening rate (mm/yr)	Shortening error (km)	Time error (Ma)
Tibet to plain	Synthesis	De Celles et al., 2002	25	500	20	100	3
far western Nepal	Line length balancing	De Celles et al., 2002 (from De Celles et al., 2001)	21	418	20	80	3
Kumaon cross-section	Line length balancing	De Celles et al., 2002 (from Srivastava et Mitra, 1994)	20	390	20	80	3
Western Nepal cross-section	Area balancing	Mugnier et al., 2004	11	205	19	40	1,5
Siwalik West Nepal cross-section	Line length balancing	Mugnier et al., 2004	2,7	39	14	6	0,3
Siwalik central Nepal cross-section	Uplifted terraces	Lavé and Avouac, 2000	0,009	0,197	22	0,01	0,00005
Basal detachment western Nepal	GPS	Mugnier et al., 2004	5E-06	0,0001	20	0,00006	0