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Review Article
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Geomorphologic Case Studies on the Current and Former Glacier Dynamics in High Asia

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Abstract

On the basis of 96 chosen, since 1976 geomorphologically investigated glaciers in the mountain-massifs of the Himalaya, Karakorum, Tibet, Kuenlun, Quilian Shan, Pamir, Kingata Shan and Tienshan there has been observed a general glacier retreat in the whole of High Asia since the LIA-1850. This corresponds to the global synchronicity as it is applied to the Quaternary, i.e. pre-historical glaciations. This trend existing over 160 years has been interrupted by at least several glaciers due to up to 5 glacier advances. Their development and extent was dependent of the special type of glacier and its interference of topography and snowline depression. The snowline depression (ΔELA) reached up to c. 40 altitude meters. Sporadically, remarkably large advances are led back to surges. Due to the mass balances, individualized by glacier-sizes and glacier-typological characteristics, a detailed, climate-genetic synchronizing within the last 160 years is not really possible, i.e. cannot really be stressed. This applies to the whole of Asia. The most homogenous retreat, however, is shown by the youngest glacier retreat in the Himalaya.

Keywords: Glacier fluctuations in High Asia; Glacier typology; Topographical factors of glacier variations; Interference of relief and climate; ELA (snowline); Lengths and thicknesses of glacier tongues; delay of time from climate change to glacier reaction; Himalaya; Karakorum; High Asia

Introduction

Despite of its subtropical to monsoon-tropical position between 27 and 43°N, High Asia due to its important height was strongly glaciated during the ice ages [1,12,24,26]and still currently has the largest extra-arctic and extra-subarctic valley glaciers with a length of c. 50-74 km (e.g. the Inyltschek- (Figure 1), Hispar-Biafo-, Siachen-, Baltoro-, Batura-glacier) and a thickness in excess of 1000 m. The change of the glacier types from a large-scale, connected glaciation during the ice age to the current glaciation concentrated only on highest plateau faces as well as separated valley networks and valleys or mountain flanks and summits at nearly the same conditions of the relief, has to be led back to the variations of the height of the snowline. This influence remains significant up to the current glacier variations, so that in the following section there has to be explained the relief-dependence of the glaciations of Himalaya, Karakorum, Tibet, Pamir and Tienshan in order to draw no precipitate climatic conclusions from the glacier sizes and –variations.

In a third section the question has to be pursued to what an extent the glacier history of High Asia is a local specific feature or goes back to global climate variations i.e. points to them.

Finally the current glacier variations in the investigation area will be introduced and interpreted as to its specific relief and climate.

Snowline (ELA) and Relief as Basis of Glacier Development in High Asia and a GlacierTypology

If the combination of the climate factors temperature and precipitation tends towards cooler and more humid conditions, the snowline drops. In case it touches the mountain relief, it sinks as far as below the level of the summits. At the same time the steepest glaciers come into being, that is the flank- or wall glaciations (Figures 2 and 3: F1). If it sinks further into the relief, glaciers with a decreasing surface incline become realized: thus the wall glacier reaches the wall foot and on average becomes flatter that means, in the beginning valley receptacle there develops the tendency towards a valley glacier with an increasing length and thickness (Figures 4-6). According to the proportions of incline of the glacier nourishing areas above, i.e. ablation areas below the snowline (ELA) (Figure 1) in the course of this valley glacier progression with decreasing ELA the glacier types avalanche caldron (Lk) (Figure 4),firn caldron- (Fk) (Figure 5), firn stream- (Fs) (Figure 6) up to firn basin- (Fm), i.e. firn-field glacier are run through (Figures 2 and 3).

The avalanche-caldron-glaciers have their orographic snowline (ELA) still in the wall, i.e. above the valley bottom (Figures 1b and 1d) into which the debris of ice avalanches falls down and then – below the ELA - again heals up to glacier ice (Figure 4). The firn caldron, however, already lies above the ELA. It receives not only supply of avalanches, but also primary snow-precipitation. In its case the snowline has been lowered to such an extent that the valley glacier has been heightened and at the valley head already is situated above the ELA (Figure 5). At the following types even the valley glacier surface – and not only the firn caldron and firn basin – runs as far as kilometers- to deca-kilometers above the ELA thus contributing by primary snow precipitation to the glacier nourishing and further ice filling (Figures 2 and 3: Fm and Fs; e.g. S-Inyltschek glacier: details of Figure 6).

At last, when the whole relief has been filled with ice, in the high mountains develops an ice stream network. This network overflew the water divides. On the high plateaus evolved a plateau glacier (Figure 1c). In this case the dimensions of the Tibetan plateau induced an ice sheet with very flat surface inclinations. This type is that one of a central firn cap (Zf) (Figures 2 and 3), that means it is a névé- and firn face

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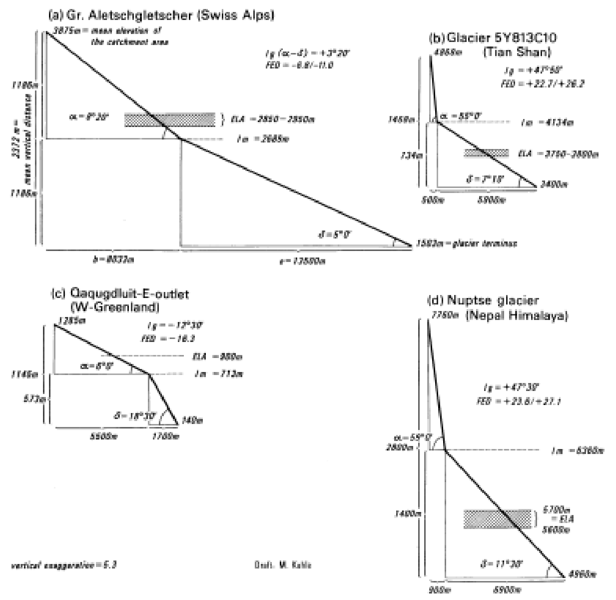

Figure 1: Schemes of exemplary longitudinal profiles of glaciers from the Alps (a), the Tienshan (b), Himalaya (d) and Greenland (c) with average surface angles above (alpha) and below (beta) the snowline (s) as glacier-typological characteristics of the relief (Figures 2 and 3). The average height of the catchment area (ϕ) is mediated from summits and notches (saddles); the vertical extensions above and below S are facing the horizontal extensions b and e.

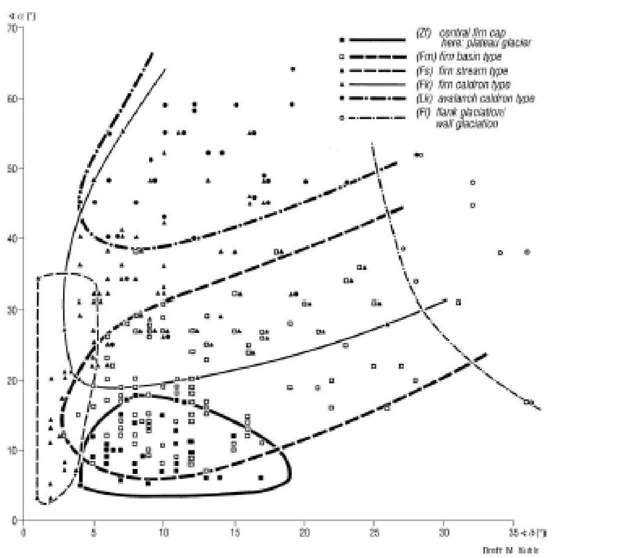

Figure 2: Glacier-typological scattering diagram of 223 actual glaciers on the basis of their nourishing-(α) to ablation-(δ) area angles in the direction of movement, i.e. parallel to the line of dip (Figure 1).

superior to the relief which is nearly completely cohesive in the ice- i.e. nourishing area.

With the help of world-wide 223 investigated current glaciers with regard to the characteristics of their relief and for a great part chosen from Asia, those 6 types of main glaciers have been extracted (Figure 2). Figure 3 is a generalized pattern of it in which the accompanying characteristics of relief- and nourishing are approached. Figure 1 illustrates by means of four cross-profiles the relief-specific, i.e. inclination-dependent glacier analysis [2-4]. There are recorded the angles of the nourishing area alpha (α) and of the ablation area delta (δ) as criteria of the inclination conditions and glacier typology, because they imply the glacier nourishing [5,6] as well as the flow dynamic and the fed back self-heightening.

According to these criteria and the resulting relief-specific glacier typology the ELA in the Himalaya must have been lowered very deeply, i.e. 1000 to 1500 m into the relief, before the type of the firn stream glacier (Fs) (Fm corresponds with an ice stream network) has been reached. This was the case during the glacial time [7]. In the Karakorum and the Tienshan this type still currently exists (Figure 6). Cause is the higher latitude as well as the minor depth of the valley and the incline of the valley bottom as it is determined by the Himalaya. In Tibet, however, even an ice sheet (inland ice) (Zf) has started to build up at a snowline depression of 600 to 800 m (ibid.). Cause of this is, that here the valley bottoms are situated in excess of 4000-5000 m ,that means twice the height as in the Karakorum, and the highest plateaus even today are showing individual plateau glaciers, i.e. central firn caps.

In What Respect the Glacier History of High Asia is Combined with the Global Development of the Climate?

The world-wide comparison shows a strikingly precise glacier synchronism also with regard to the dimensions of glacier fluctuations. As to their reconstruction of firn stream (Fs) - and ice-stream-networks (Fm) Penck&Brückner[8]have diagnosed for the nearly 100 000 km² extended glacial glaciations of the European Alps a snowline depression (ΔELA) about 1200 m for the Last Ice Age (Marine Isotope Stage {MIS} 3-2). Similar values do not only apply for other mountains in Europe,

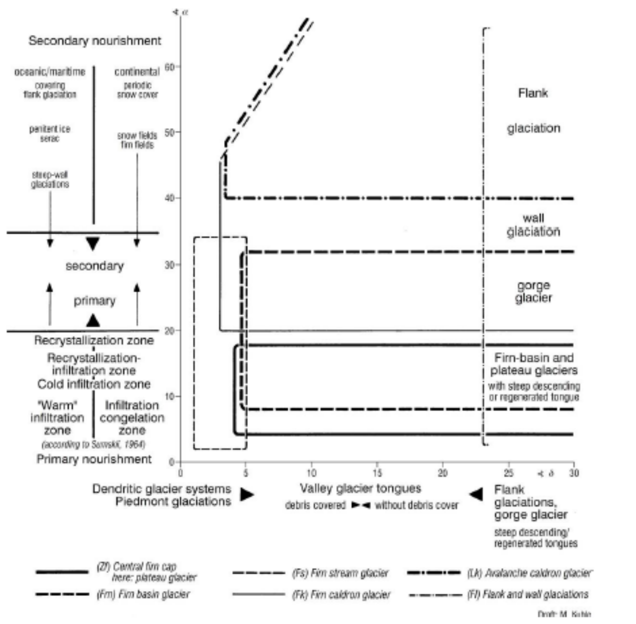

Figure 3: Glacier-typological system of 223 current glaciers on the basis of their nourishing-(α) to ablation-(δ) area angles in the direction of movement, i.e. parallel to the line of dip (Figure 2). This relief-specific glacier typology implies the characteristics of glacier nourishing.

Figure 4: North Karakorum. Seen from its orographic left valley flank at c. 4200 m (36° 7'54.70"N 75°12'43.51"E) altitude the Kunyang (Pumari) Chhish glacier upward facing N. The 7852 m-high KunyangChhish (No. 3) and its c.7400 m high E-summit (No. 2) are forming the valley head whilst its 3600 m high S-face is the nourishing area of this avalanche caldron glacier (Figures 2 and 3). The snowline runs above the valley glacier in the steep wall. From its ice balconies ice avalanches are breaking and crashing down, which at the wall foot in the valley-head-caldron (∇) are "healing-up" several 100 m below the snowline. There the valley glacier stream sets in. On its surface the debris, dragged along by avalanches, after a few kilometers melts out as a completely covering surface moraine (o). Due to the melting process during the last decades the glacier surface has dropped against the lateral moraine ridges about 20–60 m (■). Analogue photo, 24/6/1999.

but for example also for America – to quote a continent that is far away and currently as to the climate completely different. According to newer papers, the Sierra Nevada showed for instance at its continental east-slope an ΔELA about 1050 m during the Tahoe-, but also during the Tioga-Stage [9]and for the humid W-side for the same Last Glacial high stages [10] an ΔELA even over 2000 m.

So far the absolute datings on a ^{14}C-basis at most are minimum informations – if they are correct at all. Surface datings anyway are very uncertain in their glacier-stratigraphic statement [11]. Therefore first it was possible to shift the glacial glaciation of High Asia with the Tibetan inland ice extending over 2.4 Mio km² [12]by argumentation into a probably older ice age, i.e. into a middle-Pleistocene ice age. Due to tectonic uplift, resulting steep incision and strong erosion there have to be excluded glacier advances being older than Last-Glacial traces of glaciations that are preserved in the Himalaya. That is to say, there are no evidences that the Himalaya was higher before the Last Ice Age, i.e. during the middle-Pleistocene ice ages, than during the Last Ice Age up to the present time. Because the absolute altitude of the glacier catchment areas determines the glacier extension in the mountain area concerned and the climatic conditions of the last Quaternary ice ages have varied only insignificantly, during the Last Ice Age (MIS 3-2) the glaciers in High Asia had no extension worth mentioning that was less than before. At the same time there applies the empirically evidenced principle, that the glacier traces preserved in the as to the geomorphological sense extremely active steep relief of the mountains must be comparably young, because otherwise they would be destroyed already. Because here the glaciologically substantiated elements of the classic alpine ice age research in general are concerned to which we owe our knowledge of the ice ages, with regard to the method they are obligatory. So-called "absolute datings" are not able to defeat this physically based, glacio-geolocical glacier reconstruction, but - if at all – can improve it with regard to the age. Accordingly, the TCN-datings taken from the neighboring sciences are not able to replace nor to defeat the requirements of their application – that is the glacio-geomorphological reconstruction of the maximum glacier extension. A glacier chronology based only on TCN-datings, without consideration of the maximum past glacier extension, inevitably is a methodological mistake. In the meantime this has been proved by more than 1000 TCN-datings from High Asia concerned here, which are inconsistent to such a degree that they do not indicate a coherent picture of the glacial glaciation (see below section 5), though the authors [13-19] have tried to obtain this, but in an inadmissible way with regard to the method. None of these authors considers the Quaternary-Geological data in hand concerning the maximum glacier extent [12, 20-24]. Because they completely ignore these empirical facts and they exclude the polyglacial development of their regularly much too high ages against the glaciological chronology; that means against a doubtless stratigraphy.

With regard to Tibet and its surrounding mountains like the

Figure 5: Himalaya-South side. From the orographic right valley flank at 4910 m altitude (27°36'50.35"N 88°3'32.10"E) facing NE seen the Yalung glacier upward into the S-flank of the 8598 m-high Kangchendzönga. The surface of the valley glacier (o) has dropped about 60-90 m against the lateral moraines clinging to it (■). The summit crest, running over approx. 6 km at a height in excess of 8000 m, consists of four summits: 1=main summit 8598 m; 2=Yalung Kang or W-summit 8505 m; 3=South Peak 8491 m; 4=Central Peak 8482 m. Here, at a height of over 7500 m asl the about -30 to -45°C cold snow is blown away from the rocks like dry wind-blown sand. Two stair-like arranged firn caldron levels (∇)onto which snow- and ice avalanches are coming down and which receive primary snow-precipitation through-out the year, mediate down to a large avalanche caldron at the wall-foot (∇). The grey surface moraine, at first thawing out only in a thin layer, proves that the caldron is situated already several 100 m below the snowline. With its important portions of primary nourishing the firn caldrons (∇) classify this rather large Himalaya-glacier (21.5 km) as belonging to the firn caldron type (Figures 2 and 3). Analogue photo, 29/4/1999.

Figure 6: Seen the c. 55 km long South-Inylchek (Inyltschek) glacier in the JengishChokusu (TomurFeng, Pik Pobeda) -massif from 5000 m asl (42° 9'9.68"N 80° 3'29.22"E) facing W downward. Glacier upward from the section visible here, the ice-stream is running over a distance of c. 20 km above the snowline and as main-nourishing receives primary snow-precipitation on to its surface. Thus it has to be classified as belonging to the firn stream type (Figures 2 and 3). Since the last positive mass-balance during the last decades the surface of this valley glacier tongue has not melted down again, but remained stable at one and the same level or even has been heightened further. This points to an at least well-balanced, if not even positive mass-balance shown by the lack of higher lateral moraines. The lateral moraines, that means the dark surface moraine tracks (∇) thawed out from the marginal glacier ice, due to the ablation protection formed by them are producing a several meters high, residual growing-out of the underlying protected ice. Accordingly, also the medium-moraine tracks (∇), which each have been formed from two joined lateral moraines of the parent- and an inflowing tributary glacier, are growing out of the adjacent level of the ice. Accordingly, this concerns no reference to a former higher, uniform glacier surface level. Analogue photo, 21/7/1991.

Himalaya, this means the following: Only if one takes in consideration that the glacier ice – as in the test area concerned – in many places marginally has flowed down up to below of 1000 m asl and the Tibet-plateau – as evidenced by its at least 70% of ground moraine cover and erratics - was completely covered by a connected inland ice, it becomes understandable, that the TCN-dated moraine boulders have a polyglacial history.

This applies for Tibet in a strengthened way. In contrast to other ice sheet areas that have been situated in the lowlands, in Tibet even exists permafrost on a large scale [25]also in the interglacials – as well as currently [26]. Whilst under the wet-based inland ices in the lowlands the ground moraines in the ever thawing soil have been continually deformed and thus eroded, there was permafrost-bottom under the cold-based Tibet-ice. Here, the ground moraine boulders have been stopped by permafrost and accordingly have not been deformed the cold-based Tibet-ice flowed across the ground moraine that was frozen together as "solid rock", without being able to erode the surfaces of the frozen ground moraine boulders in a degree worth mentioning. Thus, the boulders that were TCN-irradiated during the former interglacials became "inheritances". That is, during the High Glacial ice coverings they did not lose their surfaces grown old by TCN-radiation. Thus they transport their TCN-ages from the former interglacial in different quantities up to present-day. This typically glaciological basic situation in the subtropical Tibet and its surrounding mountains must have led to an incomparably high portion of inheritance (probably more than 50% of the large boulders).

During the interglacials the boulders have been displaced from the superficially thawed out permafrost, the active layer, and integrated into young moraines, so that their age - apart from singular cases – is in no chronological relation to the Late- to Postglacial ice margins, but – as registered everywhere in High Asia – must be by far too high [12].

That is to say, during the Early-Glacial development of ice and the Late-Glacial reduction of ice in the course of numerous Quarternary ice ages, they have been moved back and forth by the physically necessarily manifold movements of glacier ice discharge that were dependent on the relief and the snowline (ELA). In addition, there was a non-reconstructable change of ice- and moraine covers of the surface-dated boulders during those glacials and interglacials, so that the last position of these boulders on a young moraine could be only little connected with the age of this moraine. This additionally applies in particular because the rates of surface erosion the boulder is exposed during this change of radiation and shade, must remain completely unknown. Only if one ignores the glaciogeological data of the extensive, large-scale covering cold-based glaciations of High Asia one can submit oneself to the illusion that the TCN-age of the surface of a boulder on an end moraine several hundred meters below the current glacier describes the real age of the end moraine and its glacier stage of up to several hundred-thousand years - as claimed by those authors [15-19].

However, also the purely technological side of surface-dating is still uncertain with regard to our research area. Generally it has to be stated that up to now no physically acceptable calibration of TCN-datings with reference measurements does exist for High Asia. Therefore for the time being one has to give up the thought of TCN-data there. Unfortunately also OSL-datings are not usable, because of the rather incomplete bleeching of glaciofluvial sediments.

Figure 7: Tongue of a c. 3.2 km long, orographic right side valley glacier of the Hispar valley between Yutmaru- and KunyangChhish-glacier valley in the N-Karakorum at c. 4400 m asl (36° 6'58.72"N 75°15'27.14"E). The S-exposed glacier advances strongly, what can be diagnosed by the steep, cat-paw-like front of the tongue. The ice front is so steep that every day large ice blocks are breaking down from it (↑↑). The advancing glacier overthrusts the end moraine and connected sandar (sandur) apron (■) of the preceding stage. Analogue photo, 15/6/1999.

Several authors, however, have dated end moraines at an only insignificant distance from the current glacier terminus in Tibet [27,28] and in the Himalaya [29,15]which the glacier has overthrust at an ΔELA of only 200 m and less against today before 20 up to 25 Ka (MIS 2) [23]. According to the position of the glacier-historical synchronity research since decades, this cannot be maintained anymore, because the global comparison shows a rather precise glacier synchronism also with regard to the dimensions of the glacier advances. In the world-wide comparison a snowline depression of only 200 m is usual for post-glacial, i.e. Holocene advances.

These absolute age-data not alone are necessarily wrong, because the ΔELA is much too small, but also because here a great part of the world-wide existing Late- and Postglacial end-moraine ramparts between the High Glacial end-moraine and the current glacier margin is completely lacking [30,20]. Indeed, between the lowest-preserved ice margin positions that in the Himalaya and Karakorum are situated decakilometers away and c. 2000 – 3000 m below the current glacier margins -what means a snowline depression of 1200-1500 m – c. 13 Late Glacial to Historical glacier stages can be evidenced [31,32,33]. According to their geomorphological degree of reshaping four of them have to be classified as belonging to the Late Glacial, three to the Neoglacial (Holocene) and 6 to the Historical time up to 1980 [34-37].

This corresponds approximately with the number of glacier stages for instance in the Alps and Rocky Mountains (e.g. S. Porter, who recently has compared the glacier stages in the Cascade Range and the South-Alps; personal communication 3/8/2003).

The Efforts of aGemorphologial Disproof of the Existence of a Former Tibetan Ice Sheet after Kuhle Since 1982 By Lehmkuhl[38]

After Kuhle (2013: 52)[12]:

"A further key locality lies just also immediately N of the Tsangpo as the Latzu massif of theLadake Shan (see above 1.2.13.1.) lies S of the Tsangpo. Here, the SW-spur of theNyainquentanglha Shan is situated. The Chalamba La-pass (also Shüke or TschüTschü La;5451 m asl; 29°53'N /90°07'E), too, is of especially glacial-geological interest. On this passand on the flanking mountain slopes 100 - 200 m beyond the pass depression, erratic granite

boulders are lying on bedrock rhyolithe (Fig. 15 No. 1: 29°53'48.46"N/ 90° 8'0.05"E). Theselarge rounded boulders (Photo 23) that can also be seen on the surrounding hill cupolas andremnants of old faces at corresponding sea levels, prove an Ice Age glacier transfluenceacross the pass. During two research expeditions the glacial-geomorphological situation ofthese far-travelled granite-erratics has been investigated, samples have been taken and the results published (Kuhle 1987a: 414 and Fig. 28 - 30; 1988c: 459, Fig. 2, 4, 5; 1991a: Fig. 43No. 27, Photo 43; Heydemann&Kuhle 1988: 615 - 617)[1]. According to the detailed geological map of Wu & Xiao (1991) granites outcrop only 30 – 40km further to the S and SW. There the "Lhasa Pluton" is located which has already beenreferred to in Kuhle 1988c and 1991a as the next occurrence of granite. Should the erraticboulders on the Chalamba La come from this area - what is possible but not probable – theymust have been transported up-valley. In any case this would prove an inland glaciation, whatmeans without doubt it must have been caused by a relief-overriding glaciation. But it is moreprobable that the erratics have been transported from the area of the NE-Nyainqentanglha

Shan, from a distance of ~130 km, by the main valley glacier coming from Central Tibet.However, in order to overcome the counter slope of the pass, this must have had an icethickness of at least c. 1200 m (Kuhle 1988c; 1991a). Further erratics have been mapped up toc. 12 km SW down from the transfluence pass (ibid. Fig. 43 No. 27 - 28; Kuhle 1988c Fig. 2No. 4). The corresponding valley-filling glacier discharge through the large valley concerned, situatedE to SE of the Nyainqentanglha Shan, is also evidenced by ground moraines and erratics

(ibid. Fig. 43 No. 16, 19, 20 and 24)."

[1] The claim made by Lehmkuhl et al. (2002) that these boulders are granites weathering in situwhich outcrop only a few metres above the pass-road, so that the interpretation provided by Kuhle(e.g. 1991a) becomes disproved (Lehmkuhl et al. 2002: 204), is a mistake. The crystalline compactrock outcropping on the pass is no granite - as considered by Lehmkuhl et al. - but rhyolite, whilstthe boulders deposited on it consist of granite. The unambiguously allochthonous origin of thesegranite boulders in comparison to the bedrock rhyolite has been found out by a mineralogicalanalysis (microsections and radiography) of the two rock natures and published (Heydemann&Kuhle 1988: 615, 617 see radiography Fig. 3 and 4: Kuhle 1988c: 459, 460 see microsections Fig. 4and 5). This has been indicated in Kuhle (1991a: 167 and Photo 42). Accordingly, far-travellederratics are concerned here. In addition, the well-rounded shape of these metre-sized graniteboulders proves the far-distance transport (ibid.). In the meantime this interpretation is supportedby the geological map of Wu & Xiao (1991). Lehmkuhl et al. (2002: 204) maintain that the granite -which in their opinion outcrops on the pass - does also occur in the map of Wu and Xiao (1991). Thisis wrong because of two reasons: first the Chalamba La is situated at 29°53'N /90°07'E and thus c.30 km W beyond the section of the geological map worked on by Wu & Xiao. Secondly the map ofWu & Xiao - as far as it reaches the region of the pass at all – shows a large amount of "volcanic" or"pyroclastic" rocks - as it would be for instance rhyolite - but no granite at all.

The Physical Insufficiencyof the TCN-Method for the Age-Determination

Exemplary examples of TCN-dating-errors in the Khumbu-Himalaya as well as by Seong et al. 2007 [39] in the Karakoram, of Seong et al. 2009 [19] in the E-Pamir, Owen et al. 2009 [15] on the Mt. Everest-N-side and Heyman et al. 2010 [14] in the Bayan Har

After Kuhle (2011b: 178-181)[23]:

"Due to the aridity of the research area, no 14C-data could be obtained for the dating of moraines. As has been shown in other areas of the Himalaya, up to now only 14C-datings are glaciogeomorphologically safe, whilst the OSL (optically stimulated luminiscence)- and TCN (terrestrial cosmogenicnuclids) -datings carried out so far, because of the high sea level are 4- to 10-fold overestimated, i.e. they led to too old ages (cf. Kuhle and Kuhle, 2010). Thus, by

means of 14C-datings of moraines in the KhumbuHimal, a snowline (ELA)-depression up to 500 m has been evidenced during the Neoglacial period c. 2.1 and 4.2 ka ago; whilst the ELAdepressions according to OSL- and TCN-data amounted to c. 16-23 ka, i.e. they were overestimated by a factor 6.5. Therefore the CRONUS-Earth project still draws on specific 'Production Rate Calibration Sites', which rely on conventional radiocarbon dates, in order to improve current scaling models which are still not sufficiently reliable. Corresponding OSLandTCN-overestimations are evidenced for S- and Central Tibet and the Karakoram (ibid.).

Probably the age of the TCN-data that so far have not been calibrated with regard to the highsea-level of High Asia, has been overestimated on the following grounds:

1. obviously the correction factors underestimate the amount of cosmic rays that really hit thesurfaces of very high altitudes
2. due to magnetic field excursions the amount of cosmic rays (CR) was additionallystrengthened during the Late- and High Glacial. This must have had a special effect at a highaltitude, so that the age overestimation exponentially increases with a growing moraine age.

This means, that the Late Glacial moraine stages can already be extremely overestimated as totheir age and obviously differ from the Holocene stages in a clear age leap, whilst the glacio270geological finding does not cover this leap.

Actually there are already two independent proofs with regard to an "age leap" like this of theTCN-dating in High Asia. The second hint originates from the Skardu basin (CentralKarakorum). Here Seong et al. (2007) dated the so-called Mungo glacial stage to ~16 ka. Thisstage reached or traversed in the position of the end of the glacier tongue a "Riegelberg" or"riegels" (Karpochi Rock), the moraine cover of which provides an average age of 125 ka (samples between 70 ka and 170 ka) and as "Skardu glacial stage" is classified as belonging tothe last but one glaciation (Riss or older). In this case, too, the extreme age difference is notcovered by the glaciogeological finding. In the meantime Kuhle's classification of the"Karpochi Rock-Moraine" as being from the Late Glacial (Kuhle 2001c, 2008) has beenconfirmed by Hewitt (2009a, b).

On the other hand there are also TCN-datings in High Asia which confirm Kuhle'sQuaternary-geological and glaciogeomorphological reconstruction of the glaciation. But this285 could be by chance. So, Seong et al. (2009) carried out TCN- datings of end moraines in theE-Pamir - which the author (Kuhle 1997b) has classified as belonging to the Late Glacial(Stage II-IV) - as being c. 17 ka and somewhat younger. This confirms the age determinationof Kuhle. However, unfortunately Seong et al. did not refer to the author's maps anddescriptions of the moraines concerned, though they have confirmed them at altitudesbetween c. 3550- to 3200 m. In addition, the author has evidenced in detail further, clearlylower past ice margins in the E-Pamir at an altitude below 2000 (1800-1850) m, i.e. 1350-1750 m lower. He has glaciogeomorphologically classified them as belonging to the LGM

(Kuhle 1997b). However, they were not recognized nor discussed by Seong et al..

It has to be summarized that up to now there exists no physicallys Table calibration of TCN-datawith reference measurements for High Asia."

After Kuhle (2012: 193-197)[24]:

"The objections to a Glacial Tibetan Ice Sheet founded on absolute TCN-datings.

There has been responded to objections to datings of an LGM- Tibet ice as far as up to thelocal singularities. It could be shown in detail that the Quaternary-geological evidencespublished by the present author as to a large-scale ice cover have been neglected or evenignored in favour of non-calibrated TCN- and OSL-datings (Kuhle&Kuhle 2010). At the same time it became clear, that the existing chronology on the basis of 14C-datingscorresponds with the Quaternary-geological relative chronology. This is a conformation of aTibetan Ice Sheet also during the LGM (ibid.).

Here, a further newest example with a similar argumentation against a past Tibet glaciation onthe basis of TCN-datings will be introduced and discussed, that - like numerous TCN- datingsin High Asia - is inconsistent with the glaciogeomorphology of the concerning area N of Mt.Everest.

In the Rongbuk valley on the Mt. Everest-N-slope, Owen et al. (2009) have TCN-dated twomoraine complexes T1 and T2 on the same valley cross-profile at an altitude of c. 5140 m asl (T1) and c. 5000 m asl (T2). T1 (Tingrimoraine) is dated to 330 ka, whilst for T2 (Dzakarmoraine) an age of 41 ka has been determined. The stage of preservation of bothaccumulations does not at all cover this difference in age - both of them being described as

"highly weathered" (what due to the hydrothermal decay cannot be assessed as an indicationof an especially high age (Heydemann and Kuhle, 1988). Here, the following is remarkable:despite the fact that the authors think a rate of weathering of 2.5 m/Ma to be appropriate(Owen et al.2009: 1422) this erosion has not been taken into account as to the calculation ofTCN-ages ("... we chose to express our TCN ages without correction for erosion because we

cannot predict the uncertainty with any confidence", ibid.: 1422)! However, it is standard totake into account an erosion factor between 2.5 mm/ka and 5 mm/ka (probably the last valueis more appropriate because of the intensive hydrothermal decay, see above). This meanshowever, that the true TCN-age data have to be corrected toward above and in the case of T2have to be put at ~45 ka, but in the case of T1 at min. ~600 ka or even ~860 ka (!). Thesample RON 48 of the moraine complex T1 concerns measurements of boulders of100x80x35 cm. Without age correction this boulder is dated to ~361 ka (ibid. Tab.4: 1425).Even with a minimal correction this boulder must be dated to >400 ka and thus would indicatean amount of erosion of ~1m. So, with a current volume of 0.28 m^3, the original boulderwould have had a volume of ~19 m^3, so that, accordingly, the modern boulder would haveshown only 1.4% of the original material- and to this rest the TCN-dating does refer! Inaddition it is remarkable that the moraine boulders of T2 according to the dating are only 1/10of that age and thus have undergone only 1/10 of the erosion of the T1-complex, but nevertheless the boulders do show comparable cubatures (e.g. RON 44:100x50x50 cm/ ~40 ka; RON 43: 110x80x30 cm/ ~32 ka; RON 42: 115x50x40 cm/ ~35 ka). A further point isremarkable here: at the same valley slope up-valley, at the same interval of height, the presentauthor has established with the help of radiation-range-finders (Geodimeter), installed over aperiod of 40 days, at a decline of the moraine slope of 30°, current solifluction rates of 4-8cm/a (Kuhle and Jacobsen 1988: 598). This proves an extreme reworking of the moraines.

Considering these values, an in situ exposure age of a moraine boulder of ~600 - ~860 ka atleast - probably in excess of 1 000 ka - should have the stimulating effect to think about it.Owen et al. realize that at the sight of a state of preservation like this and the position of theboulders (recently 4-8 cm/a solifluction rate) such an age cannot really be justified. Thereforethe authors arbitrarily adjust the calculation of the TCN-age to their assessment of the

gemorphological reality. Thus the fact that this way the standard interpretation of the TCN-measurementsproduces clearly overestimated values here, is suppressed. In addition, Owen etal. don't mention that at a corrected dating of their "Tingri-Stage" to ~600 up to ~860 ka– themuch more extended glaciation that the present author had already reconstructed before in thisarea (Kuhle 1988a, b, 1991, 1999) and which the authors would like to put back to the pre-lastor even older glaciations (Owen et al., 2008: 515) - then had to be dated back to about 1 MaB.P. (see above), i.e. in a time with a warmer climate and minor height in relief. How thesediscrepancies could be dissolved has not at all been approached by the authors.

To sum up and to explain, it has to be added and repeated for elucidation that:

1. the boulders which have been TCN-dated to a very different age owe their similar sizes (seeabove) to a very differently long period of surface erosion which with the same rock materialand a comparable slope position has to be described as being improbable.

2. a younger stage (T3 = Jilong moraine) has been dated to 24-27 ka, i.e. approx. into theLGM, with a pertinent ELA-depression of 150 m against today (Owen et al.: 1431).Accordingly, the supposed LGM-glacier must have had an only 15 km greater extension inlength against today's Rongbuk glacier. The ice margin position T1 = Tingri moraine, dated to>330 ka (see above) was situated only a little further down-valley at c. 4800 m asl, so thatagainst the current glacier tongue of the Rongbuk glacier at 5150 m, an ELA-depression ofonly c. 175 m has been calculated since the medium, i.e. early Pleistocene (Pre-MIS (MarineIsotope Stage) 6). Both ELA-depressions of 150 - 175 m would be global singularities, that inaddition would form a contrast to all glaciogemorphological findings on the Himalaya-N-side,in Tibet and also some decakilometres further down the Rongbuk valley. Owen et al. (2009) not consider the five or seven lower end moraines and ice-marginal positions far beyondand down-valley from their TCN-dated moraine boulders and past ice margin positions thathave been mapped in the neighbouring areas (cf. Fig. 1 Nos. 4, 5, 9, 20, 23) (Kuhle, 1987c,1988a, b, 1989b, 1990, 1999, 2005, 2007a). In addition, the authors fail to consider the erraticboulders high above the talweg, and the thick ground moraine covers presented tens ofkilometres down the Rongbuk valley, so for example at 4350 m asl (Kuhle, 1988b) and at3950 m asl in the lower Rongbuk valley and its continuation, the Dzakar Chu. Similar spreadsalso occur in the valley chamber of Kadar in the PumQu, the upper Arun valley, a furthercontinuation of Rongbuk and Chakar Chu, very high above the talweg, which lies at only just3700 m asl (Kuhle, 1991). On the basis of his ice-marginal position chronology, the presentauthor has classified the ice-marginal position in the upper Rongbuk valley as belonging tothe oldest Neoglacial stage (Nauri Stage V, c. 4.0-4.5, i.e. 5.5 14C ka BP, middle Holocene;Kuhle 2009, Table; Kuhle, 1988b). These intervals of ice margin positions and theclassification of their ice margin position into the Neoglacial were founded on 14C-datings ofthe vegetation-rich Mt. Everest-S-side (cf. Kuhle&Kuhle 2010), which is in strong contrastto Owen et al. (2009), who place the limit in the Middle Pleistocene. A snowline depressionof only 175 m for and since the glacial maximum of the Middle or even Early Pleistocene (see above) compared with the present snowline - as postulated by the authors - is not possible.

During the pre-last glacial period, the Riss Glacial, the ELA had globally dropped about c.1300 m and during the last glacial period, the Würm Glacial (Marine Isotope Stage = MIS 3-2) about c. 1200 m (see above) - to be on the safe side one has to generalize still moregenerously and state a drop of about a good 1000 m - i.e. about 6 to 7 times as much as Owenet al. (2009) postulate for S-Tibet.

3. the allegedly high degree of weathering ("highly weathered" after Owen et al. 2009) of thetourmaline granite boulders on the moraine probably results from far-reaching hydrothermalprocesses that had already taken place in the solid bedrock in the Rongbuk-catchment area at6400-6600 m asl (Heydemann&Kuhle, 1988) and on the dated boulders concerned has led toa probably still markedly higher erosion rate than those 2.5 m/Ma - applied for fresh ("bergfrisch") rock-block-surfaces -, so that in the sense of those authors a still higher TCN-agewould have to be stated. However, the age published by Owen et al. (2009) against that of"only" >330 ka, which obviously the authors themselves already think to be heightened tosuch a degree, that they have not considered any erosion rates, so that the age does not turnout to be still noticeable higher (see above).

Here it must be added that the seemingly plausible suggestion already stated by v. Wissmann(1959) that in the arid precipitation shadow of Himalaya and Karakorum no extensive glacialglaciation had existed, in 1986 had been contradicted by valley cross-profiles with freshglacier polishings and -striations in the Shaksgam- and Aghil valley (Surukwat) N of theMustagh Karakorum and Aghil mountains, reaching down to the valley bottom as far as 3400

m (Fig.1 No. 6) (Kuhle, e.g. 1988a: Fig. 6 and 7; 1994: No. 46 and 33).Here, with an average precipitation below 100 mm per year, it is not only extremely arid anddryer than on the Mt. Everest-N-side, but these glacier polishes are even c. 1500 altitudemetres below the level of the Tibetan plateau. At the same time, this has to be seen as a

further indication of the past existence of a Tibetan ice sheet.

Another example of methodically incorrect interpretations of TCN-data in High Asia has tobe added here. For instance in the Bayan Har Shan (E-Tibet) Heyman et al. (2010) havefollowed the present author and acknowledged ground moraine covers in the foreland asbeing of glacigenic origin (Fig.1 No. 3 and 19). In contrast to the present author, who hadclassified these deposits as being from an Early-Late Glacial stage of the LGM (LGP) (Kuhle1982, 1987b, 1997, 1998a, 2003, 2004), Heyman et al. (2010) put them into a separate glacialphase (BH 4), which they classify as being Pre-BH 3, i.e. older than >95-165 ka.Unfortunately they did this without mentioning the findings of the present author. De factothe six boulders of this stage from which samples have been taken, did only provide a TCN-ageof 49 ka on average (max.60.7 ka) (Heyman et al., 2010, Fig. 5, sites O and N). Thus theydiffer only insignificantly from the TCN-ages of the younger glaciation phases (BH 3 and BH2) of the valley glaciation stated by the authors themselves, from which BH 3 provides an onaverage higher TCN-age of 54.6 ka (max.128 ka) and BH 2 with on average 45.9 ka (max.79.9 ka) is scarcely younger, resp. with the maximum value is also older than BH 4 (cf.Heyman et al., 2010, Fig. 5, sites E, G, H, D (BH 2) and J, M, I, K, L (BH 3)).

Here, only TCN-data of rock surfaces (boulders) have been taken in consideration, but notthose from debris or soil profiles. The TCN-ages of phases BH 2, BH 3 and BH 4 arehomogeneously distributed among all stages and do not allow an absolute stadialdifferentiation with regard to the age. Rather the differentiation between the phases has beenestablished arbitrarily by Heyman et al. according to the relative chronology of the sequenceof stages. There even occur several age inversions, i.e. chronologically older stages showabsolutely younger TCN-ages (BH 4 younger then BH 3; site G older than site K; site J olderthan site M). Strictly speaking, the whole absolute chronology is dependent on two data, 128 ka and 110 ka (ibid.: Fig. 5, site J) in the Qingshuihe valley. However, they could have alsoreached their current positions without any problems by down-slope processes. Since they are

more than double the age than the next-older date of the stage to which they are ascribed (43ka in site M; BH 3), on recommendation of Putkonen& Swanson (2003) they actually had tobe sorted out as "outliers". With that the whole absolute chronology of Heyman et al.

wouldbe clearly shifted into the younger time, but would still remain older than the LGM. Site Fwith an age of 14.5 ka (max.18.5 ka) on average, neither can be classified as belonging to BH

2 nor to the youngest stage BH 1 (sites D and C; on average 38.1 ka; max. 52.1 ka; describedby the authors as >40 - 65 ka). With an ELA-depression (Δ ELA) of 400 m it clearly exceedsthe order of magnitude of BH 1 (cf. also the glaciation reconstruction in Fig. 12, BH 1 inHeyman et al., 2010), but according to the TCN-dating it is ~23 ka (max. ~33 ka) youngerthan that!

Summing up it has to be stated that:

1. Heyman et al. (2010) can settle their "chronology" only on 2 TCN- data and
2. All other TCN-data are dispersed to the moraines of the ice margin positions that have beendiagnosed and are in chronological contradiction as to the arrangement of their positions, i.e.the absolute age data do not show a glacio-chronological sequence from the highest icemargins as being young to the lowest ice margins as being old, as this is necessary with regardto glacier history.
3. The study shows exemplarily, that the glacial chronology can only be inferred from thesequence of stages, but not by way of TCN-datings.
4. The nearly corresponding TCN-ages of all recessional stages point to an at glacial timescomplete glacier cover in the sense of the present author (Kuhle 1982, 1987b, 1997, 2003) themoraine boulders of which have only been redeposited during the Late Glacial advances anddislocated a little after deglaciation."

Immanent contradictions of TCN-data as well as extreme discrepancies of TCN-data with regard to ^{14}C-dated lake-ages

In one of the most extensive studies of this sort [13] 241 ^{10}Be-datings from the whole Tibetan area have been summarized and statistically evaluated. However, the resulthas shown no correlation of the glacial advances at all – neither among each other nor with the global minima of the temperature or precipitation-maxima.

A further record of data that is relevant for the judgment of a Quaternary glaciation of Tibet, are the absolute datings of lake-levels and lake-fillings in the area of the plateau. In the meantime there exist ^{14}C-datings of drill-cores from lake-sediments for the whole plateau-area. Here there are attained Late-Glacial ages of <19 ka at maximum for Lake DonggiCona[41]. The other lake-fillings, however, are of a clearly younger date: Lake Naleng<17.7 ka[42], Koucha Lake <16.7 ka[43], Lake Kuhai<14.8 ka[44], Siling Co <14 ka[45; <12 ka 46], Sumxi Co <12.7 ka[47]Lake Zigetang<10.8 ka[48], Cuoe Lake <10.5 ka[49], Bangong Co <9.5 ka[50]and Nam Co <8.4 ka[51; > 7.2 ka after 52]. The highest lake-level, however, correspondingly for all lakes – also DonggiCona – is reached only in the Early or Middle Holocene [41,44].

Significantly, drill-cores of lakes situated outside of the maximum inland-ice-extension of the LGM reconstructed by the present author (Kuhle), provide clearly older chronologies, so e.g. Lake Luanhaizi<45 ka[53], Lake Quinghai<69 ka[54], Lake Tengger<42 ka[55] and Lake Manas<37 ka[56].

The TCN-datings of past lake-terraces, however provide very high ages of lakes in the area ofthe plateau as e.g. >216 ka for Siling Co or >271 ka for Tangra Yum Co. Several high lake-levels, however, also are situated about 3.8 ka (Drolung Co) or <15 ka (Zhari Nam Co) [57]. Similar to the TCN-datings of glacier-fluctuations, also the TCN-datings of high-lake-levels do not provide a synchronous chronology in Tibet[57].

The unknown primary conditions of TCN-datings according to the proportions of incoming radiation

Not even the largely unknown theme-complex of the geomorphological erosion rates of the rock surfaces concerned needs to be estimated (see above). Not alone for High Asia, but in general the physical conditions of the TCN-data do not accomplish the physical preconditions of the TCN-datings that are necessary for an absolute dating. This applies anyway, because "surface exposure dating" is concerned here, that has to get along without knowledge of the surface erosion that has taken place, because the surface erosion cannot be known. But also the physical preconditions demand that at most "^{10}Be-years" can be indicated [58, cited according to 59].However, to explain these as being absolute age-datings is dishonest. Because as far as now the factors of influence of the local TCN –production rates, with the size of which ostensibly is dated, to a great extent are unknown to the research of physical fundamentals. Because of this even the involved Cronos-Earth-project fears a loss of credibility of the TCN-dating [60, cited ibid.]. Balco[61, cited according to ibid.] notes that the production rate of the nuklid necessary for datings, the half-life period and the passing on nuklid-concentration in many places are not known [62, cited according to ibid.].

After the investigations of Seguin [59]as to - with regard to the TCN-production – also important question of the pole reversal of the terrestrial magnetic field, there are the following indications by Lynch 2011[63, quoted after59]: During the last c. 20 millions of years there has taken place a pole reversal of the magnetic field at medium intervals of c. 200 – 300 Ka. The last pole reversal has taken place c. 780 Ka ago (ibid.). Seguin says further: "With regard to the influence of a pole change on cosmogenic nuclides, however, no literature has been found. Because the magnetic field during a phase of pole reversal is in a radical change and thus gets weakened, galactic as well as solar cosmic radiation might hit the earth stronger, so that the nuclide-production would be heightened. However, up to now no complete disappearance of the magnetic field has been evidenced (cf.Lynch 2011)" [59]. However, a change of poles like this does not take place all of a sudden, but within several millennia [63, cited after 59], what makes the influence even more complicated.

A further influence on the TCN-production is taken by the deformation of the terrestrial magnetic field due to the sun wind, i.e. the heliosphere[64, cited according to ibid.]. Depending on what the incoming galactic cosmic radiation concerns, i.e. a high – or low-energetic radiation, according to Li et al. [65, cited after ibid.]the influence of the solar magnetic field on the GCR is different [66]. Also influence on the terrestrial magnetic field [64, cited after ibid.] and thus on the TCN-production rate have the solar flares and the coronal holes. Seguin [59]concludes from the connected-by Campbell[64, cited after ibid.]measured output of protons - to a strengthening influence on the nucleon cascade. The TCN-dating literature, however, does not care at all.

Obviously indisputable is the coupling of climate changes and thickness of the earthly atmosphere. At the same time a relationship to solar activities is seen in this [67, cited after ibid.]from which Gosse and Phillips [58, cited after ibid.] infer a change of the TCN-production rates. In this connection the intensity of the geomagnetic storms has to be referred to. This is dependent on the 11-year solar circle [64, cited after ibid.] and influences the GCR.

From references like these Seguin deduces a strengthened nucleon cascade and, accordingly, thus higher production rate of cosmogene nuclides, e.g. across S-America [cf. 64]. This might be caused by the weakness of the magnetic field there. Furthermore it establishes that "anomalies like these", leading to such excessive TCN-datings, "at the moment are not taken in consideration" [59]in the TCN-dating literature.

In addition, the factor of the surface cover and thus the shielding of the rock surface of the covered rock needs consideration in connection with the TCN-dating. Here, the period of time of the past vegetation cover is unknown. The dating of moraine boulders starts from the - however unknown- assumption that since the deglaciation classified as belonging to it there has existed no new cover or erosion. For example, the climate-dependent past snow-cover can be registered only very incompletely. Assessments like these are only due to implied actual, seasonal values of snow-thicknesses. Because the seasonal influence of snow can lead to differences in age up to 15% [58, after ibid.].Merchelet al. [68 cited after ibid.]admit its importance and at the same time point to its indisputable unknownness. Also important factors of influence are the shadowing by surrounding mountains as well as the incline of slope at the TCN-sample locality [69,58 cited after ibid.].

The inheritance-problems as to the Tibetan plateau have already been discussed in detail [12]. Naturally older TCN-datings, going further back, among others due to these insecurities as to power and duration of the surface covers in addition are fraught with negative associations.

Masarik et al.[70, cited after ibid.]think the influence of the absolute altitude on the TCN-production rate to be not important. Other authors [61, 69 cited after ibid.]assume an increase of the cosmic radiation intensity together with the absolute altitude. This interpretation is based – among others – on the decreasing pressure of the atmosphere [see also 66,58,71 cited according ibid.].Thus for the TCN-dating- tests in High Asia a strong over-dating is probable (i.e. the TCN-ages are too high) [21,22].

Seguin [59]complains that as far as today the Chapter "Estimation of production rate" in Gosse and Phillips [58, cited after ibid.] for many TCN-dating-personnel serves as a relevant basis for their age estimations, though these – according to the informations of these authors themselves are only estimated.

Also Lal[71, cited after ibid.]provides concerning estimations. Seguin[59] is especially surprised about the latter ones, because this author has pointed out before that a little mistake of 10% in connection with the concerning calculations (that actually are incalculable) of the nucleon cascade must lead to a mistake of 120% at sea level, i.e. in the lowland[71, cited after ibid.]. With the statement "Accurate estimations of production rates are generally not possible because of lack of knowledge of the probabilities of formation of nuclides in the different reactions"[71] for Seguin [59] the unavoidable question is connected, why TCN-datings are carried out, though the here necessary production rates of the different nuclides- due to the unknown reactions in the nucleon cascade – are not known. The criticism of the author even goes further by her taking Chronos-Earth at its word: The overall goal of CHRONOS-Earth is to put the systematics of terrestrial cosmogenic nuclide methods on a firm foundation. It is not intended to fund development of new methodologies or site-specific investigations" [60] and she sneers at the fact that in spite of that the models of CHRONOS-Earth are available for age-datings with Be and Al free of cost online, especially since "… several basis –informations, as e.g. the exact production rate of Be or the influence of the Myon-production are still not settled ..." [59]. Accordingly," the approach is made possible for a greater group of researchers and the results become comparable. Possibly, there could also develop more and more mistakes due to ignorance or unclean work, because all researchers again and again refer to the same models, without improving them."(ibid. 45-46)."In this way" - so the author also participants of CHRONOS-Earth as e.g. Susan Ivy-Ochs herself [72]…" contribute to this trend and also to new, but methodically not established possibilities of applications. Accordingly, CHRONOS-Earth indeed is inconsistent with its intention cited above.

In the same way unsure as to a strong age dating that corresponds with the reality, are the requirements on a TCN-sampling locality. There are necessary extensive, horizontal areas, so that mountains have to be omitted for TCN-datings. Cause of this is the extensive shielding due to valley flanks and mountains. In the same way unsuitable is the strong erosion in a mountainous steep relief [58,73]. Because the concerning TCN-dating-personnel are trying to replace these requirements – that in the mountains do not at all exist – by so-called correction-factors, the already existing age-insecurities are still increasing. Accordingly, the following applies: so long as the aim would be restricted only to the production of TCN-data in the form of "^{10}Be-years", a sample-application as to the question of ages like this would be only useless. However, if the Be-data obtained are declared to be a dating, a misleading is concerned. Astonishing enough, among Quaternary geologists one can even hear the statement: "Better wrong dates than no dates". Unfortunately the present author is not able to agree on this understanding of science.

In the glacial-chronology that within a glacier forefield is unambiguous, TCN-data of "^{10}Be-years" can only be controlled as to their sequence, but not as to their absolute age [21,22]. Compared with the intersubjective verifiable evident arrangement of the positions of mechanical-physically unambiguous ice-margin indicators that need absolutely no correction-factors, TCN-data have an inherent position in the test-hierarchy. Thus they have a minor empirical value of reality.

Despite this shortly summarized, to a great extent unsolved basic and methodical conditions, the majority of the publications deals with the naïve application as TCN-dating. Accordingly, in fact first the astrophysical conditions of the TCN-production must be clarified. Actually they decide on the applicability for the dating. It is absurd, but here the second step is made before the first. Finally Seguin [59] stresses "… that the TCN-dating still is far away from being an exact and reliable method for the absolute dating of ages …"

In contrast to this the following remark of Dunai[74]seems to be optimistic: "Depending on the nature of a surface (glacial feature, lava flow etc. ...), independent ageconstraints may be derived from diverse techniques such as radiocarbon-, luminescence- and Ar/Ar-dating, as well as dendrochronology and varve chronology .... At its simplest, a cosmogenic nuclide production rate is calculated from the measured nuclide concentrations in a sample, divided by the surface's independently determined age." In the area we are speaking about, that is in High Asia, in the meantime TCN-data for e.g. "^{10}Be-years" have been collected, but they have not been calibrated in the way proposed by Dunai. On the contrary, glacial features and radiocarbon-datings always were ignored by the dating-personnel in case they did not correspond with those "^{10}Be-years". Quaternary-geologically and geomorphologicallyso far not calibrated TCN-data like these have been deposited - exactly as if they were of an absolute order - above "the nature of a surface" and its genetic context [21].

The demand for absolute age-data is understandable, but it is not allowed to seduce to an ostensible optimism despite of a dysfunctional method. Otherwise there exists the risk to pursue only a fashion.

New results on the terrestrial magnetic field deny the usefulness of TCN-data for the determination of ages: The global weakening and regional shifting reconstructed by the "Swarm"-project, i.e. the instability of the terrestrial magnetic field in its position and intensity during the Holocene are cause of variations of the global and local shielding effects up to a factor of ~100 [75,76]. This means that actually-regionally 100-times the cosmic radiation is hitting than in the neighborhood on the same latitude-degree.

In addition, the magnetic-field is able to change its global intensity for a short time[77]. So, its intensity e.g. has been weakened during the last 100 years about 5% (ibid.).Regionally there has taken place a decrease like this even within only 10-15 years (ibid.). There have been measured regional weakenings, but also opposite strengthenings (amplifications) within only 6 months (ibid.).

Since 2013 the three "Swarm"-satellites [78]are measuring with magneto-meters the deformation of the terrestrial magnetic-field by "sun-storms" ("Sonnenstürme") [77,79];furthermore the influence of the magnetic field by the petro-variance of the earth-crust (ibid.) and the feedback factors of influence of convection-streams and earth-rotation in the interiorof the earth (ibid.). Important mass-removals such as these reach distances of c. 10 km per year (ibid.). Accordingly, this only partly known "Geodynamo" modifies the magnetic field. So, the shifting of e.g. the magnetic pole amounts to 90 m per day (ibid.).

Merely this refindly measured lability of the terrestrial magnetic field denies a reference-system and makes TCN-datings impossible.

None of the reference-systems postulated by the TCN-dating-persons as a condition is valid.

Dunai[74]has shown with his publication "Cosmogenic Nuclides – Principles, Concepts and Applications in the Earth Surface Sciences"that theoretically it would be possible to apply the TCN-technique, in case the empirical conditions for it were available at all. However, this is not the case.

The way how Owen, Heyman, Schlüchter, Schäfer, Chevalierand others are dating TCN may be "modern", however, because these are blank data they are data of no value.

Current Glacier Fluctuations in High Asia

Only against this theoretical and empirical background the following observations as to the current glacier dynamics in High Asia can be a useful indicator with a global- climate-genetic interpretation.

The large, over c. 30 km long Karakorum glaciers have melted back at their tongue termini and in part have lost c. 30-100 m of ice thickness in the very flatly inclined ablation area since the last building-up of lateral moraines c. 180-80 years before today (Figure 4). This applies for the Hispar-[80,Photo 4.3], the Biafo-[32,Photo 65 - 67, 69, 70, 74], the Batura-, the Chogolungma- (ibid.: Photo 105, 111, 114, 117, 118, 121, 123, 125, 126) and also the Sarpo-Laggo glacier [81,Figure 44, 46]. This going-back, however, in some cases - as e.g. that one of the c. 55 km long Baturaglacier – was interrupted by advances. Between 1885 and 1930 here has happened a strong advance up to or even across the Hunzariver that between 1910 and 1930 has been observed in detail by the inhabitants of the Pasu settlement [82]. After a phase of retreat between 1930 and 1960 there has taken place a new advance up to 1978 [83].The melting process up to 1987 and a following stagnation have led to the fact that in 1992 the submerged dead-ice-glacier-end passes over in moving ice only 1.8 km further upward of the Hunza river, that is upward of the Batura valley. From 1992 up to February 2005 (cf. Google Earth) there was nearly the same situation, i.e. the process of melting-back persisted. The c. 39 km long Skamri glacier in the Karakorum-N-slope, adjacent to the c. 21 km long Sarpo-Laggo glacier, in this group of large glaciers, too, is an exception, because it is about to advance 1976 [81, Fig 49]and then stagnation up to 1986 (ibid.: Fig. 37, 48). But up to September 2009 (cf. Google Earth) it melted back c. 2.9 km since the authors field-observations in 1986 (ibid.: Fig. 9). The c. 60 km long, heavily ramifying Baltoro glacier [32;Photo 1, 5, 8] of the south-west-slope turns out to be strikingly stabile with its lowest ice margin position (ibid.: Photo 48 – 50, cf. Google Earth: March 2010).

In the group of the c. 20-30 km long valley glaciers the picture is more heterogenous. So for instance the c. 21 km long, north-exposed K2-glacier [81]clearly advances in 1986 (ibid.: Fig. 23, 23a), whilst the Skyang glacier adjacent in a NW-exposition, melts back very heavily and thus loses height of the surface(ibid.: Fig. 11). Since my field-observations in 1986 the K2-glacier melted 260 m back up to September 2009 (cf. Google Earth).

During the last 40 years also the c. 28-30 km long Momhil-, the c. 26 - 29 km long Yazghil- [84, Fig 9; 85, Photo 5 and 6] and the c. 23 km long Malangutti glacier (ibid.: Photo 7) advanced in phases, but then again their tongues melted back a little. Glaciers like the strongly branching-out c. 20 km long Sot Maro-Kukuar-, the c. 19 km long Toltar-Baltar- and the c. 17.3 km long Hassanabad glacier, however, since 1950 i.e. 1930 are in the process of a strong recession. In the context of this short overview it is not possible to go in detail into the eventful history of the oscillations of this glacier tongue termination [86, 87, 83, 36, 37]. - In these mountains the Himalaya glaciers of this category are the largest existing ice streams; the longest Himalaya glacier is the c. 31 km long Gangotriglacier. Without exception they are in the process of recession, i.e. its surface-moraine-covered surface sinks down increasingly (Figure 5). Examples are e.g. the c. 17.6 - 18 km long Ngozumpa glacier [33, Photo 119, 122-125, 132], the c. 15 km long Barun glacier (ibid.: Photo 1-3, 5, 6, 8), the c. 12.3 km long lower Barun glacier (ibid.: Photo 9-11), the c. 19 km long Kangshung glacier [88, Photo 100 – 102, 104], the c. 15 - 16 km long Rongphu (Rongbuk) glacier [89, Fig. 58, 59, 66, 69], the c. 12 km long RongphuShar glacier (ibid.: Fig. 67, 68, 70-73) and the c. 17 - 18 km long Khumbu glacier [33, Photo 55, 63, 64] on the Mt. Everest-E-, NE-, N- and S-side, the Yepokangara glacier [89, Figure 42] and its parallel-glaciers in the Shisha Pangma-N-slope, the c. 14 km long Kyetrak glacier [90, Photo 21 - 24], all glaciers of the Dhaulagiri-, Annapurna- [30] and Manaslu-massifs, the c. 19.54 – 23.8 km long Kangchendzönga glacier [1, Figures 1 and 9]and the c. 19.73 km long Yalung glacier (Figure 5).

The rest of the in terms of the numbers largest representatives are the some kilometers up to 15 or 20 km long glaciers. In the Karakorum and Nanga Parbat massif some of these sizes were in the process of advance since the beginning nineties, so e.g. the c. 13 km long Liligo Glacier [32, Photo 37, 38], the c. 6 km long valley glacier in the southern orographic right side valley of the Masherbrum glacier, the c. 4 km long Kunti glacier in the Rakaposhi-W-flank, the c. 6 km long Mango glacier [32, Photo 68]on the orographic right side of the Biafo ice-stream, several nameless glaciers on the orographic right side of the Hispar glacier (Figure 7), the c. 7 - 7.5 km long TippurGans glacier (ibid.: Photo 129, 130) in the Basna valley, the c. 17 km long Gulkin glacier and the c. 14.6 km long Rakhiot glacier [91, Photo 92, 94-97, 100, 102-105, 112]on the Nanga Parbat NW-slope. However, most of this category are in the state of stagnation. There is no report of the author on an advance in the Himalaya.

In the SE-Tibetan c. 7760 m high NamcheBawar-massif (29°37'52.75"N 95° 3'17.84"E) and also in the comparable E-Tibetan MinyaKonka-massif the glacier shrinkage during the last century is also evident. However, here too, with important exceptions. So, for instance, the NamcheBawar-SW-glacier, which currently comes to an end at c. 3900 m [88, Photo 68], about 1950 has flowed down up to c. 2900 m, damming up the Tsangpo river that here, immediately above the meridional stream-furrows, was very important (ibid.: Photo 70). At the outburst of the ice-dammed lake, its flood has destroyed several settlements and probably has killed (far) more than 100 people. This event has been evidenced by inquiries and also due to its dating of dead ice and moraines with the corresponding vegetation (betulautilis) (ibid.: 174 - 176, 190 - 193).

The glaciers in Central Tibet, so for instance in the Tanggula Shan, are in the process of retreat; in 1989 the Geladaindong-E-glacier in the upper Gar Qu had already retreated nearly 2 km from its 2 km wide "Little Ice Age" (LIA) tongue basin [88, Photo 5 and 6; 84, Fig. 13] and during this process has left behind dead ice boulders in size of a house [92, Photo 70]. Some glaciers of the Nyainquentanglha in S-Central Tibet, too, in 1989 have melted back a little, whilst others have stagnated [88, Photo 33].In 1981 the central Kuenlun-glaciers still were about to retreat and in 1991 they already advanced again. In 1996 the Gangdise Shan glaciers (E-NganclongKangri) also had tight tongues and advanced [90, Photo 81]. This applied also for larger glaciers as the Halong glacier in the Animachin massif in northern E-Tibet about 1981 [93, 94]. Now the Halong glacier is retreating (Google Earth: January 2008).

As a sample of a plateau glacier, i.e. a glacier of the type "central firn cap" (Zf) (Figures 2 and 3) the Dunde glacier with its numerous outlet glaciers, hanging down on all sides from the Kakitu-plateau in N-Tibet (Figure 1c) has to be named. In 1981 all these small tongue ends, reaching down into valleys, were in the process of melting-back [95, Figure 17].

Without being able of going in detail into the wealth of glaciers visited in the E-Pamir [91, Kongur: Photo 30, 42 – 44; Muztagh Ata: ibid. Photo 54 - 57], in the Kingata Shan (Chakragil–massif: ibid.: Photo 1 and 2), Tienshan(Figure 6) and Quilian Shan [96], there too, can be observed the somewhat mixed picture typical of High Asia. In 1991 the c. 55 km long South-Inylchek (Inyltschek) glacier (Figure 6) in the JengishChokusu (TomurFeng, PikPobeda) -massif was nearly stable; several of its dendritic tributary-glaciers retreated insignificantly, whilst others advanced at the same time. The Petroff glacier in the AkSchirak massif (TerskeyAlatau) on the Tienshan-plateau, however, at the same (summer 1991) retreated rapidly and released a c. 9.5 km² large tongue-basin, filled with a melt water lake (Petroff Lake).

It can be stated as being certain that the glaciers in High Asia have lost ice volume by melting back, i.e. melting down since at least 80 years. Statistically, however, this fact is not easy to corroborate, because it is mainly the with regard to its number largest group of the small glaciers, the regression of which has been interrupted most frequently by advances. This applies mainly in the continental-semiarid areas and the areas of winter-precipitation. In the monsoonal Himalaya the retreat is unambiguous. In the monsoonal SE-Tibet once more the picture is more heterogenous.

This heterogeneity that can be recognized by the shiftings of phases i.e. –time as well as by the widths of advance and retreat, against the background of the interference of relief-surface and snowline-depression (ΔELA) i.e. –uplift among others has the following causes: If the ELA is uplifted in a steep wall at the valley head, then this means an only minor reduction of the horizontal outline of the nourishing area and the glacier remains nearly unchanged, whilst adjacent glaciers with flat nourishing areas are heavily melting back.

For this reason e.g. the lower ice margin of the Sachen glacier in the Chongra peak E-flank in the Nanga-Parbat-massif - the snowline of which in the upper section of the flank, that is in the steep Chongra-E-wall, varies since centuries - did nearly not change since A. Schlagintweit have described it in the 19th-century (September 11th,1856) up to the year 1987, when it was visited together with W. Kick [cf. 97, 91, Photo 84]and even up to 5/31/2011 (Google Earth) over more than 155 years.

A further cause of insignificant glacier shrinkage, compensating the climate-depending uplift of the snowline, is the more than decimeter-thick overlay of surface moraine (Figures 4 and 5) as it is characteristic of glaciers with predominant avalanche nourishing and also of the large dendritic valley glacier systems, i.e. the avalanche caldron- (Lk) and firn caldron-glaciers (Fk) (Figures 2 and 3). Up to a debris thickness of c. 10 cm the surface moraine debris strengthens the up-heating and ablation by its insignificant albedo [40, 92]. At a larger thickness – and this exists for the by far predominant part of the upper moraine cover – it works as a protection against ablation.

At those relatively large, steep-flanked and strongly ramified valley glacier systems belonging to the firn caldron type (Fk), a proportion of nourishing- to ablation area smaller than 50% : 50% up to 30% : 70% as it can be met at the Baltoro glacier (see above), points to the fact that the valley glacier by its meter-thick surface moraine received an increased independence on the climate. As to an immediately climate-dependent sheer ice complex the proportion 66-55%: 33 - 45%: (AAR (Accumulation Area Ratio) = 0.66 – 0.55) would be in the climatic equilibrium.

In this connection the Baltoro glacier provides a remarkable example. This c. 60 km long, in its central confluence area near Concordia 3 - 4 km wide [32, Photo 5 and 4] and about 1000 - 1300 m thick ice-stream has the extreme AAR of c. 0.33, i.e. extraordinary small faces of firn- and avalanche caldron-, i.e. nourishing areas. Though the glacier could not build-up under this extremely unfavorable nourishing situation, the final position of its glacier tongue is nearly the same since decades. Obviously here a valley network has been filled with ice during the glacial time and due to the heightening of its glacier surface – that, accordingly, during the year over months was covered by a snow layer on the upper moraine – could be preserved stabile through the Holocene to Historical warming-up [32].Independent of a stability of large valley glaciers like this, due to their important distances from their nourishing areas to the tongue end, they are showing a much longer delay of the glacier advance, i.e. glacier retreat, than short glaciers, so that part of them advance whilst the others at the same time are melting back.

For all these reasons the glaciers that through, the nourishing- and further on the ablation area up to the tongue end are inclined relatively uniformly and without breakages – and naturally these are those that are only a few kilometers-long -,react most undamped and most immediately to climate changes (Figure 7).

A further relief-dependent disturbance factor are glacier-pulsations by "surges", i.e. sudden, mostly strong glacier advances, that because of abrupt reductions of friction in or on the ground of the glacier ice have been released. They probably happen again and again periodically after the nourishing- and ablation areas of a longer valley glacier have newly been filled. Accordingly, they also don't allow an immediate climatic interpretation (e.g. NamcheBawar-SW-glacier; see above).

Summary of the Results on the Current Glacier History in High Asia

Since about 1850 (Little Ice Age) there takes place in High Asia – like in the Alps – a back-melting of the glacier tongues and a decrease in ice volume. However, as far as today this process is interrupted by glacier advances that might be synchronous with adjacent regressions. This has to be led back to each glacier with its relief-conditions own reactions and their delay to positive or negative mass balances.

The so-called global warming is reflected by a nearly general glacier retreat in the Himalaya. This is correct for the Himalaya, but not for the whole High Asia. For other parts of High Asia the picture of the current glaciers is still too heterogeneous.

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