1.1 Background

One of the most significant and far reaching geologic events during the Cenozoic is the collision between the Indian subcontinent and Eurasia (Zheng et al., 2013). The resultant uplift of the Tibetan Plateau (TP) (Fig. 1.1) and the westward retreat of a vast inland ocean (Paratethys Sea) had major consequences for climatic and environmental evolution on a global scale (e.g. Ramstein et al., 1997; Molnar et al., 2010; Bosboom et al., 2014; Wang et al., 2014a; Wang et al., 2014b; Liu et al., 2015). The sequence of events dramatically modified the Asian landscape with widespread aridification and the onset of an extratropical monsoon circulation (Sun and Wang 2005; Guo et al., 2008; Liu et al., 2015). The general perception is that during the Early Cenozoic, and before large-scale uplift of the TP, the environments of East Asia were dominated by a zonal climate with a broad semi-arid zone, resulting from the planetary atmospheric motions (Westerlies) (Fig. 1.2a; Wang et al., 2014b). Over the course of the Cenozoic, environments in East Asia gradually developed into a monsoonal dominated system with an extremely arid continental region separated from a humid margin near the oceans (Fig. 1.2b).

The exact timing and mechanisms of the formation and evolution of a monsoonal climate with associated aridification is subject of debate. A complicating factor in this debate is that the transition to a monsoonal climate is probably also variable on a spatial scale. Nevertheless, the onset of loess deposition is a good indicator for widespread aridification of the Asian interior. The discovery of 22-25 Ma loess deposits in Qin’an (Central China), suggests that the onset
**Figure 1.1** - (a) Map of the Earth with an inset indicating East Asia. (b) An overview which depicts the locations of important geographical markers in the East Asian landscape (circles). 1: Gobi Altai Mountains; 2: Taklimakan Desert; 3: Qaidam Basin; 4: Qilian Mountains; 5: Alxa Arid Lands (AAL); 6: Ordos Block/Basin; 7: Bohai Bay; 8: Qinling Mountains; 9: Sichuan Basin. Core LYH is located in the southern part of the Fenwei Basin, which is indicated by a red dashed outline and the letter 'W'. The largest rivers originating from the Tibetan Plateau are indicated by blue lines. 1: Yellow River, 2: Yangtze, 3: Red River, 4: Mekong, 5: Salween, 6: Irrawaddy, 7: Brahmaputra, 8: Ganges, 9: Indus. ECS and SCS stand for East China Sea and South China Sea respectively. (c) Topographic map depicting the location of the Weihe Basin, relative to major geomorphic units in its surroundings. The red dot indicated the position of core LYH. CLP stands for Central Loess Plateau. The CLP and the Mu Us desert are located on the stable Ordos Block. Nr 1 to 4 indicate the cities of Baoji, Xi'an, Weinan and Sanmenxia respectively. Blue lines are river; numbers in squares indicate: 1: Yellow River, 2: Wei River, 3: Jing River, 4: Luo River and 5: Sichuan River.
of aridification in Asia already started at least in the Late Oligocene (Guo et al., 2002; Qiang et al., 2011). This is also in line with recent findings on the formation of the Taklimakan Desert (Zheng et al., 2015) and comprehensive reconstructions of paleo-environments based on geo-biological and geological evidence (Sun and Wang 2005; Guo et al., 2008; Wang et al., 2014b). Although aridification in China appears to go back to pre-Neogene times, the monsoonal evolution is associated with several periods of intensification. For example, since the start of the Quaternary, the accumulation rates of eolian dust in terrestrial China increased dramatically, with loess also being deposited over a much wider area (e.g. Ding et al., 1999; An et al., 2001). An et al. (2001) showed through grain size analysis of loess deposits, that the intensity of monsoonal circulation strengthened around 2.7 Ma, linked to tectonic activity on the TP and the extent of the northern hemisphere ice sheets. The latter suggests large-scale teleconnections between northern hemisphere climate and monsoonal dynamics in East Asia (Fang et al., 1999).

A major consequence of the uplift of the TP and the associated monsoonal intensification is the development of an extensive drainage network with several of the largest river systems on Earth, such as the Yellow River and the Yangtze (Fig. 1b). The rivers transport large quantities of eroded sediments towards the continental margins. In fact, the concentrations of suspended particles carried south- and eastward from the plateau are larger than any on Earth (Clift et al., 2008). Not all sediments end up in adjacent seas and oceans, but are partly trapped in intracontinental (rift) basins. These basins form a terrestrial repository for thick stacks of sediment which provide a first-order insight into the paleoclimatic evolution in relation to tectonic forces (Gawthorpe and Leeder, 2000). Compared to other records, the benefits of the analysis on fluvio-lacustrine records in rift systems is that the temporal duration is long, because successive periods of crustal extension utilize existing fault zones. Furthermore, rifts have a potential high time resolution and depositional continuity (Cohen, 2003).

1.2 Study area

The Weihe Basin (Fig. 1.1c) is one of the largest intracontinental rift systems in China. The basin lies at the transition from the arid to the semi-arid zones, where the climate is controlled by the East Asian Monsoon (EAM) and the westerlies. This region provides an
ideal natural laboratory to examine the interaction between tectonics and Late Cenozoic monsoonal climate evolution. The Weihe Basin is not only highly relevant for investigating the monsoonal influence on terrestrial systems, it also forms a key region in the development of China’s second largest river; the Yellow River (Sun, 2005; Huang et al., 2009; Hu et al., 2012; Kong et al., 2013b; Hu et al., 2016). Previous studies point toward the existence of the Sanmen Lake in the Weihe Basin, acting as the local base level for the Yellow River and its tributaries (Kong et al., 2013b). Although the extent of this lake is still unknown, a possible sudden drainage would most certainly impacted the evolution of the Yellow River and the sedimentation in and beyond the Weihe Basin (Jiang et al., 2007; Zheng et al., 2007; Prins et al., 2008) (see chapter 2 for more information on the Sanmen Lake). It can be assumed that the sedimentary record, stored in the Weihe Basin, has a great potential for understanding landscape development over the Late Cenozoic in relation to (monsoonal) climate change and large-scale tectonic geomorphologic perturbations. In chapter 2, a more detailed description of the geology, tectonics and hydrology in the Weihe Basin is given.

Core LYH was drilled in what currently constitutes a wetland complex (Luyang Wetland) in the northern Weihe Basin, Shaanxi Province, Central China (Figs. 1.1; 1.3). The name of the core is derived from the Luyang Lake (lake = hu in Chinese), which is an artificial lake in the vicinity of the coring site. The drill core is located 5 km to the West of this lake at 34°48’43.49”N; 109°31’53.95”E. The wetland is part of a shallow depression of approximately 60-70 km². The decision to drill at this location was based on minimising the erosive influence from large river systems (like the Wei and Yellow Rivers) over the most recent past and on an expected potential long temporal record. Eventually, the total length of the core reached 1097.2 m. The core is divided into three parts (LYH-1, 2, 3) but for this thesis we focus on the top 221 m of core LYH-1.

1.3 Sedimentation in intracontinental rift basins

Over long timescales, sedimentation in intracontinental rift basins commonly evolves through predictable stages (Withjack et al., 2002). Initially, rift basins are generally small and sediment supply is adequate to keep pace with subsidence. As a consequence, the basin remains filled with sediment and rivers, shallow lakes, and swamps typically occupy the rift basin, as is the case for the modern African rift valley (Cohen, 2003). However, when
extension proceeds, sedimentation often does not keep pace with subsidence rates and a deep lake will develop. A good example of such a lake is Lake Baikal, currently the deepest lake on Earth. When subsidence rates slow down during the later stages in the rift development, the lake will gradually disappear as major axial river deltas and alluvial fans will fill in the basin. An important consideration in long term sedimentary conditions is the distinction between open and closed intracontinental rift systems. In closed systems, water and sediment fluxes are largely conserved, while open systems are prone to erosion and are dependent on sedimentary cycles of axial rivers.

The rift structure as well as the magnitude and timing of rifting events exert an important control on the sedimentation in rift basins (Frostick and Reid, 1987; Gawthorpe and Leeder, 2000). The catchment and depositional areas evolve with respect to relative linear detachment faults, defining the basin margins. The position of the major detachment faults determines the location of maximum subsidence within basin segments and the areas of thickest sediment accumulation. A common feature in rift basins is the development of a series of asymmetrical half-graben structures with listric (flexural) detachment faults, which are segmented along strike. These half-graben basins have elongated dimensions and can reach a length of several kilometers. Depending on structural, climatological and hydrological control, the half-grabens might be filled with permanent or ephemeral lakes with transverse sediment fluxes. The sedimentary sequence of the basin fill is characterized by distinct cyclothems of fine grained lacustrine sediments alternated by coarser grained sediment influx (Frostick and Reid, 1987; Blair and Bilodeau, 1988; Scholz et al., 1990).

Due to a sudden decrease in gradient between the footwall and hangingwall, the margins of rift basins are characterized by a sequence of talus cones, alluvial fans, fan deltas or even submarine fans. In the absence of a large lake (or sea), these fan systems might coalesce to form bajadas with episodic occurrences of playa lakes. The size of alluvial fans and bajadas are a function of tectonic activity. Vertical offset between uplifted footwall blocks and subsiding hangingwall blocks give rise to modifications in the drainage network, sediment flux and changes in stratal thickness in hangingwall depocenters (Whipple and Traylor, 1996; Blair and McPherson, 2009). If sufficient subsidence is generated, a complete sedimentological record can be preserved that is otherwise reworked by fluvial and/or eolian processes. Although tectonic activity is a first order control on sediment flux, additional controls as climate change, hydrological conditions and catchment bedrock lithology make the sedimentation in extensional basins quite complex (Gawthorpe and Leeder, 2000). Climate exerts an important control on sedimentary fluxes through its effect on water availability, weathering rates, erosion rates and vegetation cover. As the climate in China is strongly influenced by monsoonal variations, it is expected that this system had a profound influence on the sedimentation patterns in the rift basins of this region.

1.4 Monsoonal dynamics

The monsoon is an important component of the Earth climate system, and plays a significant part in the global hydrologic and energy cycles. In general, monsoonal climates are found where continental landmass is located poleward from an equatorial ocean (Webster et al., 1998). By definition a monsoonal climate is characterized by a strong seasonal change in
wind direction associated with alternation of rainy and dry periods during the year. This results mainly from the contrast in heat capacity of continental and adjacent oceanic areas because land has a relatively small heat capacity, so that whatever energy the surface receives from the sun (and via thermal radiation from the atmosphere and clouds) is transferred almost immediately to the overlying atmosphere. In addition to the much greater heat capacity of oceans, the internal mixing within the ocean results in a buffering effect, which exerts a strong influence on the sea surface temperatures.

The Asian Monsoon is part of the Asian–Indian Ocean–Australian monsoon system, which is considered to be the most extreme on Earth in terms of its intensity and spatial extent (Clift and Plumb, 2008). It determines for a large part the distribution and intensity of rainfall over mainland Asia. The Asian monsoon can be subdivided into the South Asian Monsoon (SAM), mainly originating from the Indian Ocean and the East Asian Monsoon (EAM),
Climate and tectonic influence on alluvial dynamics in the Weihe Basin, Central China

originating from the East and South China Seas. A distinguishing feature of the EAM is its spatial extent, which covers the extratropical regions of Asia, thereby disturbing the planetary climate system (Sun and Wang, 2005; Guo et al., 2008). The EAM, exhibits a distinct summer and winter component (Fig. 1.4). During the East Asian Summer Monsoon (EASM), anomalous heating of air over Central Asia and the subsequent formation of a low pressure system draws moist air from the Pacific Ocean towards the Asian landmass (Fig. 1.4a), resulting in abundant rainfall with a northwestward migrating Meiyu front. The East Asian Winter Monsoon (EAWM) is controlled by reversed atmospheric conditions. The continent cools and an anticyclone high pressure system develops above Siberia, which results in dry northwesterly continental winds that blows outward from the continental landmass towards the adjacent seas in the east and southeast (Fig. 1.4b). During warmer climatic intervals (interglacials or interstadials), the average EASM is stronger and hence moisture levels inland increase significantly. Contrastingly, during colder intervals (glacials or stadials), the EAWM is stronger (Porter, 2001).

The uplift of the TP is often attributed as a key component in the inception and subsequent intensification of the EAM system, because the exceptional high altitude favours ascendant convection (Kutzbach et al., 1993; Boos and Kuang, 2010; Molnar et al., 2010; Wang et al., 2014a; Liu et al., 2015). The general idea is that the plateau acts as a sensible heat pump, which causes moist atmospheric air mass to be pushed towards greater altitudes where it converges and condensates, ultimately creating an additional latent heat source in summer and heat sink in winter (Kutzbach et al., 1993). This amplifies seasonal contrast with a stronger summer and winter monsoon in response to growth of the TP. The extensive size and altitude of the TP also created a rain shadow in the northwest of China as well as strongly modified atmospheric motions around the plateau. This contributed to aridification in northwest China (Manabe and Broccoli, 1990), further reinforcing seasonal contrast of atmospheric motions. By following this line of reasoning, it has been suggested that the formation and intensification of the EAM coincides with large-scale uplift of the TP (An et al., 2001). As discussed above, the EAM varies in strength over glacial-interglacial timescales. The uplift of the TP resulted in enhanced chemical weathering as alteration of silicate rocks consumed CO₂. The reducing trend in atmospheric CO₂ (a greenhouse gas) since the uplift caused global cooling during the Cenozoic (Raymo and Ruddiman, 1992) and gave way for the glaciations during the Pleistocene, which ultimately influenced monsoonal circulation (see below).

The northward drift of the Indian plate and the subsequent continental collision with Eurasia not only created the massive TP, but also drastically changed the land-sea configuration, with the westward retreat of the Parathethys Sea (Bosboom et al., 2014) and the opening of the South China Sea (Zhang et al., 2007). These two events facilitated an enhanced thermal contrast between the Asian interiors and the adjacent oceans, which affected the EAM (Ramstein et al., 1997; Fluteau et al., 1999).

1.5 Previous research on the East Asian monsoon

The EAM has been studied in oceanic and terrestrial settings. The most complete continental monsoon records in East Asia can be found on the Central Loess Plateau (CLP) (e.g. Liu, 1985; Liu and Ding, 1998). The CLP is located directly north of the Weihe Basin (Fig. 1.1c)
and comprises an estimated surface area of 360,000 km² (Bird et al., 2015). Eolian dust accumulated as a thick blanket over the preexisting morphology. These loess deposits are composed of homogeneous non-stratified yellowish silt, alternated by layers of darker reddish buried soils, commonly referred to as paleosols. In total 33 paleosol and loess layers were distinguished over the Quaternary period (Heslop et al. 2000). The loess-paleosol sequences typically reflect the EAM climate (e.g. An et al., 1990; An et al., 1991; Porter, 2001; Kohfeld and Harrison, 2003). On the CLP, the effects of the northwesterly EAWM is reflected in both a decreasing trend in thickness of the loess deposits (Fig. 1.5), as well as a fining trend in grain size towards the southeast of the plateau (Derbyshire et al., 1998; Porter, 2001; Kohfeld and Harrison, 2003; Nugteren and Vandenberghe, 2004). This is directly related to the proximity to the source as is suggested by Yang and Ding (2008).

The grain size and thickness not only varies spatially over the CLP, but also shows a distinct temporal variation and is a powerful tool to determine the intensity of the EAWM on an orbital timescale (Porter, 2001). Grain size maxima in the loess-paleosol succession mark times when the transport capacity of dust bearing winds increased (Porter and An, 1995). An increase in grain size as well as in sedimentation rates is observed during glacial periods, when the EAWM was more powerful (Fig. 1.6b) (Ding et al., 1995; Lu et al., 2002; Nugteren and Vandenberghe, 2004; Sun and An, 2005; Prins and Vriend, 2007; Prins et al., 2007). The humid EASM gains power during interglacial periods, which promotes the formation of soils as vegetation and chemical weathering will start to expand in poorly consolidated fine grained loess. Magnetic susceptibility (MS) and several geochemical (weathering) indices have been widely employed to reconstruct EASM intensities (Fig. 1.6c) (Kukla et al., 1990; Maher and Thompson, 1991; Han et al., 1996; Balsam et al., 2004; Hao et al., 2012). The positive correlation of MS records with independently derived geochemical weathering records, like the Rb/Sr record (Chen et al., 1999) illustrates the general validity of both indices to reconstruct summer monsoon intensities in the loess deposits.

The source of the loess has great implications for the reconstruction of past paleo-climates and sedimentary environments in East Asia. A common perception is that the Gobi Desert and the proximal deserts that make up the Alxa Arid Lands (AAL; Fig. 1.1b) serve as the dominant source for the loess on the CLP (Derbyshire et al., 1998; An, 2000; Sun, 2002; Chen et al., 2007; Sun et al., 2008). However, recently this model has been subject to debate. Maher et al. (2009) argue that multiple sources must be held responsible for the extensive accumulation of loess on the CLP. This concept is consistent with other provenance studies (using detrital zircon dating, geochemical parameters and electron spin resonance), suggesting a wide latitudinal range of arid regions between the Gobi Altai Mountains and the northeastern TP (Sun et al., 2008; Li et al., 2009; Li et al., 2011; Pullen et al., 2011; Xiao et al., 2012; Che and Li, 2013; Stevens et al., 2013; Bird et al., 2015; Nie et al., 2015; Licht et al., 2016). This makes the extraction of climate signals fro the loess-paleosol record significantly more complex and probably not as straightforward as previously thought. Several studies argue that the provenance regions have shifted over orbital timescales, in pace with glacial-interglacial alternations (Sun et al., 2008; Kapp et al., 2011; Pullen et al., 2011; Che and Li, 2013). A 10° latitudinal equatorward shift of the westerlies from an interglacial to a glacial could subsequently result in a source change from the northern deserts to the Qaidam Basin on the northeastern Tibetan Plateau. If such source change over orbital timescales is correct, then it has a significant effect on the observed sedimentary characteristics of the loess. To make things even more complex, a recent study suggests a prominent role of the Yellow River as a
Figure 1.6 - (a) Variations of the 100 kyr eccentricity cycle (dashed line) and the average June solar insolation at 65°N. (b) Stacked loess mean accumulation rates (MAR), reflecting the strength of the winter monsoon (Sun and An, 2005). (c) Stacked magnetic susceptibility record, reflecting the strength of the summer monsoon (Hao et al., 2012). (d) Stacked $\delta^{18}O$ speleothem record, reflecting the intensity of monsoonal rains (Chen et al., 2016).

Figure 1.7 - (a) Spectral analyses, based on the Stacked $\delta^{18}O$ speleothem record of Chen et al. (2016) a) Fast Fourier Transform spectrum. This shows that the dominant frequencies are 23 and 19 kyr, associated to precession cycles in Earth's orbit. (b) Wavelet power spectrum, showing how the forcing by precession cycles varied over time. The forcing is relatively continuous, except for a period between 350-450 ka, when a lower frequency cycle appears to be present. Both plots are created by the PAST software package (Hammer et al., 2001).
source. Yellow River sediments were eroded and transported to tectonic depressions located northwest from the Ordos Block (Stevens et al., 2013; Nie et al., 2015; Licht et al. 2016). Through this mechanism, the river actually creates the sandy deserts from where the EAWM picks up the sediments to be subsequently deposited on the CLP.

On shorter timescales, speleothems deposits make ideal high resolution archives for the reconstruction of the EAM (Fig. 1.6d). Through the crystallization process, they incorporate the oxygen isotope character of the water from which they form. It has been demonstrated that negative $\delta^{18}O$ values correlate to increased monsoonal rainfall (Wang et al., 2001; 2008; Cheng et al. 2009; 2016). The broad scale evolution of the $\delta^{18}O$ record follows precession-driven cyclicity (Fig. 1.7), implying that the strength of the summer monsoon is largely driven by variations in incoming solar insolation. Relatively rapid shifts in the speleothems $\delta^{18}O$ demonstrate that the intensity of the East Asian monsoon switched in phase with abrupt climate transitions, like the one from the Bolling-Allerød to the Younger Dryas (Cheng et al., 2016). However, despite the correlations to northern hemisphere solar insolation, there appears to be a dampened response of the monsoons to this forcing, because transitions in the speleothem record are usually longer (Cheng et al., 2016).

Lacustrine records provide other valuable archives to study paleo-environmental evolution within the realm of terrestrial settings. Lake dynamics and the nature of detrital influx are dependent on precipitation and run-off. Numerous studies on lacustrine deposits in the northeastern TP and the arid lands of China have demonstrated that the variations in lake and salinity level are strongly related to the amount of rainfall generated by the EAM (e.g. Mischke et al., 2005; Herzschuh, 2006; Colman et al., 2007; Chen et al., 2008a; Liu et al., 2008; Hartmann and Wünnemann, 2009; Liu et al., 2009; Long et al., 2012). In general, lake expansion occurs at the transition from the LGM to the Holocene (Herzschuh, 2006), suggesting a direct link of the monsoon system to glacial-interglacial variations. Such a conclusion is also supported by recent findings of lake expansion during MIS 5 in the Ulan Buh Desert (Li et al., 2015). Although the time coverage of most lake records is limited, the few long cored lake records that do exist indicate Milankovitch forcing with cyclicity in the obliquity and eccentricity bands (Colman et al., 2007). Superimposed on the orbital cycles are many small amplitude millennial and centennial-scale oscillations, which highlight the complexity of sedimentation in lake basins.

From the research on the loess-paleosol sequence, it is obvious that the windblown sediments, comprising the CLP are a valuable archive for past (monsoon) climates. However, the spatial and temporal variability of the provenance regions for the CLP loess limits the usability of loess deposits regarding paleoclimatic studies (Stevens et al., 2013). Defining past atmospheric circulation patterns remains problematic and subject for debate as boundary conditions evolved over time. The high resolution archives in lacustrine deposits and speleothem records do not have the temporal duration to deal with long term trends in monsoonal variation.
1.6 Aims and objectives

As the livelihood of the most densely populated regions on Earth is closely linked to monsoonal precipitation and the fact that this also gives rise to major disasters like floods and droughts (e.g. Yancheva et al., 2007), it is pivotal to gain a better understanding of mechanisms and trends in monsoonal variation. Despite a continued accumulation of geological evidence on paleoclimate in East Asia and advances in the integration of these records, there are still many uncertainties regarding monsoonal evolution, its forcing mechanisms and how it affects the environmental and sedimentary systems over time.

The relative deep and continuous fluvio-lacustrine records in the Weihe Basin can provide new information, on the Late Cenozoic variability of the EAM system. In addition, the basin is located in the middle reaches of the Yellow River. The sediments stored in the basin can help to elucidate the evolution of the river. Therefore, the region provides an ideal natural laboratory to examine the interaction between tectonics and climate and to quantify rates of landscape evolution.

It has long been acknowledged that tectonics and climate have a controlling impact on sedimentation in intracontinental (rift) basins (see 1.3). The sedimentary sequences associated with the environmental evolution in such basins have the potential to provide valuable insights in how basin forming tectonics and climate interact. In case of the Weihe Basin, these two factors are linked to the uplift of Tibet and the alternating monsoonal climate that dominate the central regions of China. However, in order to deduce climatic and tectonic signals, it is essential to understand the sedimentary mechanisms that are and were active in the basin.

The main objectives of this thesis are to understand the Middle to Late Quaternary sediment infill of the northern Weihe Basin in terms of past environmental and sedimentological conditions. In order to do this, it is important to unravel the evolution of the fluvial systems on the sedimentary environment and to decipher whether a large paleo-lake had existed over the investigated time span. The obtained paleo-environmental reconstructions will be discussed in terms of tectonic forcing and climate variations in the region. This will allow us to deduce the impact of the EAM on the sedimentation in the study area. As the monsoon is strongly driven by cycles in the Earth’s orbital parameters, we discuss the sedimentary properties with respect to these Milankovitch cycles. In addition to deciphering climate impacts, another important objective of this thesis is to obtain an understanding of how tectonics affects sedimentation in the northern part of the Weihe Basin.

1.7 Outline

This thesis is divided into seven chapters. Apart from the general introduction (chapter 1), the geological and hydrological setting is presented in chapter 2. This is followed by four peer-reviewed scientific publications (chapter 3-6) and a synthesis (chapter 7).

In chapter 3, a lithofacies analysis of core LYH-1 is presented to reconstruct environmental and sedimentary conditions since the Middle Pleistocene in the northern Weihe Basin. The reconstruction is based on a detailed macroscopic description alongside a variety of analyses, including micro-paleontological analysis, grain size analysis, thermogravimetric analysis
and color reflectance analysis. In order to adequately make this reconstruction, a comparison of the core sediments with modern environments in the Weihe Basin is made. This provided us with 5 lithofacies representing 1) eolian, 2) fluvial flood, 3) lacustrine suspension, 4) playa and 5) soil deposits.

In chapter 4, a combination of element geochemistry, mineralogical and organic matter content is used to further unravel the sedimentary sequence as discussed in chapter 3. It is proposed that the subdivision between detrital influx and periods of enhanced evaporative concentration are mainly the result of major climatic alternations.

Chapter 5 presents sedimentological and morphological analysis on the Luo River, which flows proximal to the drill site. A reconstruction of the Late Pleistocene evolution of the river in the northern Weihe Basin is given. This chapter aims at linking the evolution of this river to major sedimentary evolution in core LYH-1 as deduced from analyses in chapters 3 and 4. The central question in the chapter is when and why the river stopped its contribution to the subdued wetland area.

Chapter 6 presents a refined age model for the analyzed core interval by comparison to the well-dated loess paleosol sequence of Chinese Loess Plateau. The newly established chronology is used for spectral analysis on proxies related to sediment flux, carbonates and grain size. A combination of Fast Fourier Transform analysis and wavelet analysis were applied on a selection of proxies to obtain periodicities in the sedimentary sequence, which might be related to climate change, tectonic perturbations and autcycliclity.

Chapter 7 synthesizes the previous chapters and summarizes the most important results of the PhD thesis. The main focus is on the effect of (monsoonal) climate change, tectonics perturbations and autocycliclity on long term sedimentation in the northern Weihe Basin. In this chapter, I address whether the alluvial sequence can be used as archive of past East Asian monsoon variation. Finally, this chapter provides an outlook for future research.