

PROGRESS IN FLOODPLAIN SEDIMENTATION AND ENVIRONMENTAL RESEARCH

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Abstract: Floodplain deposits are deposits formed when rivers flood the plain., is an important carrier for watershed environmental research. in recent years, related to floodplain sedimentation Environmental research involves watershed environmental evolution, ancient flood, environmental archeology and flow area ring territory Sewage dye and flow area ring territory back scene wait collar area. return Forget it 20th century discipline 80 years The main progress in floodplain sedimentation and environmental research over the past generations, focusing on the beach sink product much Sample sex and sink product special levy, river comic beach sink accumulation ring territory refer to mark of meaning righteous, The application of floodplain sedimentation in paleoflood and watershed environmental pollution research is reviewed and analyzed., Consider floodplain sedimentation to be diverse and complex, Floodplain sedimentation has made great achievements in ancient flood research and basin environmental pollution. big quantity research study become Fruit, now back answer add powerful river comic beach sink product and gas wait Change change, river comic beach Study on sedimentary characteristics and material sources, there are many rivers in our country, regional differences are obvious, and floodplain sedimentation and environment have attractive research prospects.

Keywords: Floodplain sedimentation; Sedimentation characteristics; Ancient flood; Environmental pollution

1 FLOODPLAIN SEDIMENTARY CHARACTERISTICS

River landforms are widely distributed on the surface. For more than half a century, rivers Geomorphology has made great progress in theoretical and applied fields. floodplain It refers to the mainly vertical accretion formed by flooding outside the river bank. Fine-grained sediment is an important type of river landform and is the basis of flood plains. important components. In the field of sedimentary geology, including floodplains in The study of river sedimentary facies in China has a long history and is related to floodplain sedimentation. A related environmental study is paleoflood research. 1954 Leop old and Miller is pregnant Russian bright state East department river flow river comic beach sink product research under study After emphasizing the relationship between floods and floodplain sedimentation [1], Follow Heman Research on beach sedimentation and paleofloods is increasing day by day, and related paleofloods Water Hydrology in the 20th Century 70 — 80 years generation early step shape into [2], and At Officially launched in 1982 Life name for antiquity flood water water arts Learn [3]. according to according to river comic beach. The sedimentary record is very recent,past, or the flow and frequency of prehistoric floods Reconstruction can extend the river flood history to a scale of hundreds or even thousands of years. To make up for the shortcomings of instrumental hydrology, in the determination of extreme flood levels and their plays an important role in water conservancy engineering applications.

river comic beach sink product and ring territory do for one across study scientific hot point research research, which has received great attention in fields related to global change, floodplains Geochemical information from sedimentary records is used over large areas or watersheds Geochemical mapping at a large scale [4], in watershed environmental assessment and environmental management plays an important role in. As human environmental problems become increasingly severe Against this backdrop, environmental pollution research has received increasing attention. River Man The beach is the land ball surface layer Tie Tongzhong Sewage dye material Heavy want store live field Therefore, well-preserved floodplain sediments can reconstruct the pollution history or heavy pollution of the watershed. Big pollution incident Pieces [5-6], become for flow area ring territory Sewage dyed Heavy want since Ran files case. Over the past decade or so, Chinese scholars have also conducted extensive research on river flooding Research on floodplain sedimentation and environment, the research objects involve modern floodplains,river Paleofluvial floodplain deposits on flow terraces and flood periods at gully confluences Residual sedimentation, etc., especially in the Yangtze River, Yellow River and its tributaries, Han River Basin have carried out a large number of floodplain sedimentation and environmental research work, mainly Research on ancient floods involving the Quaternary Period, especially since the Holocene,environment Archeology and other fields.

This article mainly reviews the recent Floodplain sedimentation at home and abroad in the past 30 years Research advances with environmental studies in key areas, from floodplain sedimentation Starting from the characteristics of river floodplains, we analyzed the relationship between floodplain sedimentation and environment of different environmental indicators. application in environmental studies, focusing on floodplain sedimentation and paleoflux,environment Make a comprehensive elaboration on the two aspects of pollution and analyze the future floodplain sedimentation. Prospects and analysis of related fields of positive and environmental research.

1.1 Diversity of Floodplain Sedimentary Types

Floodplain sediments are widely distributed on the surface, and the sedimentation during their formation Dynamic and sedimentary environment, geographical location, human activities and climate conditions, etc. can affect the sedimentation characteristics of floodplain sedimentation, so floodplain sedimentation product types are diverse. on some large river basins,middle, the river downstream floodplain, in its sediment source, geochemical properties and mechanical composition, etc. There are differences in all aspects; the floodplains in some river valleys are affected by tectonic,gas The impact of river erosion caused by factors such as climate change has resulted in the formation of structures that remain in the river The river terraces in the valley, the sediments that make up the terraces record earlier Floodplain deposits from the past, some extreme flood events can inundate terraces on which shape become Year light flood water Expect sink product (equivalent to At river comic beach sink product).

The time scale for the formation of modern floodplain sediments is approximately $10^0\sim 10^2$ years, generally distributed in valley bottoms near rivers, often during floods Submerged by floods, due to the sedimentation caused by floods, rivers overflow The vertical accretion of the beach topography increases, forming a relatively continuous floodplain. sedimentary record. Platte river yes USA dense West Sibby river superior tour branch flow, A modern floodplain deposit about 350 cm thick records the Since people settled in America (approximately 1830)relatively continuous environment in the basin changes, including 14 great floods and at least 3 periods of people Sedimentary records of mining-like activities [7].

Central Spain Tagus Three levels of terraces developed in the middle reaches of the river. These three terraces are respectively higher than the river bed. 17, 12 and 10m, Save separately many floods water deposition one Yuan, including as many as 31 third -level terraces a [8]. middle reaches of the Yellow River of Qin river Low level land superior reserve Got it one individual 8cm. Thick floodplain advection deposits, with underlying thickness of 1. 3 m river channel sediments, overlying 0. 43m of slope sedimentary layer, and this floodplain sedimentary layer Indicated 6183 ± 328 aBP antiquity flood water thing Part [9]. yellow river from The second terrace where the Guanting Basin enters the Sigou Gorge is deposited with a thickness of about 2 m The floodplain sediments record what happened in Between 3700~2800 aBP 14 times special big flood water [10]. exist yellow river flow area Guanzhong pot In this area, the valleys of Qishui River and its tributary Meihe River develop 15~20 m not connected Continuing the terrace, the Huxizhuang section on the terrace can identify two sets of ancient floods. sedimentation, these two sets of ancient flood sediments can be divided in detail into 5 layer groups, Among them, 4 groups of flood deposits were formed between 4300 and 4000 aBP ago. a group formed in 3100~3010 aBP, Every Group Can by Draw point like Dry a flood sedimentary unit [11]. In addition to the terraces, the holes on the valley slopes hole, concave wall, gaps and other locations are also important areas for the formation and preservation of floodplain sediments. in Spain Llobtegat of river 8 bedrock alcoves Saved in total 56 flood sedimentary units, among which the oldest flood water sedimentary formation At about 2,600 aBP [12]. exist Law country South The bedrock of the Ardèche river gorge valley have May many Hole hole and concave Wall, grind study Higher than normal water levels found 16. 5 m preserved in an alcove of 9. Flood sedimentary unit, year generation most Long of flood water shape become At about 700 ± 80 aBP [13]. Heavy celebrate Loyal county Dry well river Down Traveling dam legacy site The T0102 exploration section covers a long period from the Neolithic Age to modern times. 5000 years old Almost intact cultural layers, with Qing Dynasty preserved between each cultural layer, Mid-Song Dynasty, Early Warring States Period, Western Zhou Dynasty, Xia Dynasty and Neolithic Age six palaeoflood layers [14].

The above floodplain sedimentation types are diverse, and the middle and upper reaches of the river Floodplains are often accompanied by sedimentation of coarse-grained gravel during extreme flood events. The accumulation, alternating thick and thin flood sedimentary units record multiple flood events. Floodplain sediments are distributed in landforms that are easy to preserve in river valleys. Some studies focus on the preservation of higher landforms in valley terrain. Floodplain sedimentation, but there are relatively few studies on floodplain sedimentation and palaeofloods in downstream floodplains.

1.2 Structural Characteristics of Floodplain Sediments

Floodplain sediments are mainly composed of alternating coarse and fine particles during flood periods. is characterized by finer-grained sand, silt and clay accumulated very common. Due to the local-scale hydrodynamics within the valley geomorphological unit Different characteristics result in different grain size characteristics of river floodplain sediments, which has a negative impact on the river. Particle size analysis conducted on the floodplain of the Xiantao River section in the lower reaches of Han Dynasty found that the Gaohe River The particle size of the floodplain is relatively fine, and the silt-grade component is 49. 56%, clay The content is approx. 4. 87%; low comic Beachy grain path Mutually right partial coarse sand class Group Divided into 82. 96% [15]. in the upper Mississippi Valley of the United States Tributaries, with strong flood power, carry sediments on the floodplain Often thicker, eggs stone,huge gravel wait yes often visible flood water comic beach sink product Things [7]. Spanish tooth Llobregat river Monistrol attached close high out river bed 15. 5 m antiquity flood water sink product host want for sand quality pink sand, powder sand Contains The amount is 59. 2%, sticky earth Contains quantity is 12. 5% [16]. river comic beach sink product The particle size characteristics of materials are mainly affected by the river ratio, running water carries sediment in Wear and tear during migration and changes in flow dynamics caused by the scale of the flood Therefore, the grain size characteristics of floodplain sediments in the upper, middle and lower reaches of the same river are also different. in

south africa Mkuze River, upper stream The modern floodplain sediments in the area are generally coarse, mainly composed of fine sand and medium sand. into, its components are 60% ~70%, in Down tour land district river comic beach sink product The particles become finer and are mainly composed of silt, containing quantity about for 90% [17]. one There are also different grain size characteristics within each flood sedimentary unit. secondary flood Water sedimentary units often have a binary structure, gradually evolving from sandy sediments at the bottom to silt or sandy silt [18].

1.3 Structural Characteristics of Floodplain Sedimentation

Common floodplain sedimentary structural features are horizontal bedding, wavy bedding and thin bedding. Horizontal bedding structures typically flood water in floodplains After relatively uniform flow of sediments, there are some single horizontal bedding structures. The layer thickness can reach more than tens of centimeters, and some single horizontal bedding structures The thickness of the layer is measured in millimeters, which is usually the case when the water flow is extremely slow. tiny under circumstances hanging float thing quality of sink product [19]. do By exist South Beijing attached close During the field investigation of Yangtze River floodplain sedimentation, a large amount of thin-layered water was found Flat bedding structure, single layer thick Spend Past Past for 1~2mm, have of one layer Not even thick 1 mm. The wavy bedding structure is a concave and convex layer It is undulating in profile. This structure is mainly formed during floods. It is formed in the reciprocating oscillatory motion or forward motion. The former forms a more symmetrical waveform, and the latter forms an asymmetrical waveform. Generally speaking, wavy Many bedding structures shape become exist water depth ratio compare shallow of beach noodle on [19]. exist West Spain department of Tagus river by At river comic beach superior water flow flat Slow, sandy Particles cannot cross the wave crest in the wave mark and continue to flow in the direction of the wave mark. As a result of aggradation, the ripple marks move in the upstream direction, and the climbing wall that migrates upstream develops. Rising wave shape layer theory [8]. exist West class tooth West north local Llobregat river, partially climbing ripples due to fluctuating flood flow rates and high sand content Down migrating Climbing ripple, upper part for the same phase climb Wave Traces [12].

In addition to these common sedimentary structures, river floods in different places Beach sedimentary structural characteristics are different. In the Three Gorges section of the Yangtze River, yellow The gravel beach surface of the Sanmenxia section of the river and many mountainous and hilly rivers, You can clearly see the imbricated structure, which is mainly manifested as The long axis of coarse-grained material (such as gravel) is mostly perpendicular to the direction of water flow. direction, while its flat direction is tilted against the direction of the water flow, forming coarse-grained matter Minimal resistance to water flow required to maintain stability, many flat surfaces Coarse particles tilted against the flow form an imbricated structure with each other, which is a good way to judge floods. water water flow direction of Heavy want mark Chi [19]. exist Mountain district river In the flow, floodplain sediments also have unique terminal structures. these rivers Floodplain deposits are located on gently sloping platforms and are caused by varying thicknesses. Due to unequal compaction and the influence of terrain, end warping often occurs. Characteristics of rise and fall, survey found in the reaches of the Yellow River below Sanmenxia Now, the horizontal distance extended by the tilted end is about 45 ~ 50cm _ , The ends are raised The height is 5 ~ 10cm No etc., with Down volt slow song Wire of slope Spend have Off [20]. Caves on the valley slopes of the river valley, the floodplain sediments in the concave walls are mainly Develop parallel bedding. The development of these parallel bedding is related to floodplain sedimentation. flat bottom by and sink product hour Expect not yet by arrive lead lead flowing film ring Related [12]. some thick layers of river comic beach sink product one Motonai department without have bright obvious structural features, referring to Show flood water Expect between sink product material quick speed sink Product [1 8]. This kind of sedimentation is especially obvious in fine-grained floodplains. The author found this in the south Similar rapid changes were also found in field surveys of Yangtze River floodplain sedimentation near Beijing. rapid sedimentation mud layer.

Floodplain sediments also have exposed genetic structures, biological remains structure etc., these structural features are often used as important criteria for dividing flood units. ambition. For example, some floodplain sedimentary unit layers in the terraces of the upper reaches of the Yellow River The rain mark structure developed on the top surface [10]. After the flood, due to flood sedimentation element exposed to null In the air, content easy shape become mud split, such as West class tooth Mud cracks are developed on the surface of the Tagus River beach sediments [8]; in Qishui, Guanzhong Basin Typical crack structures have developed in the river valley terrace floodplain sediments [11]. The author recently collected sediments deposited on the floodplain under the Nanjing Yangtze River Bridge in the lower reaches of the Yangtze River. During the investigation, it was also found that there were a large number of surface layers of flood sediments on the river floodplain. mud crack structure. The surface layer of flood sediment after a flood is often will form due to move thing or plant animal life move make bioturbation Traces [16]. have some River Man beach sink product also Bag Contains have burn burn to stay down Carbon filings [21], Indicates human activities after the formation of flood sediments.

2 FLOODPLAIN SEDIMENTATION AGE

Chronological analysis is the basis for studying the floodplain sedimentary environment. work, the current common floodplain sedimentation age analysis techniques are mainly radiation sex carbon Measurement Year, light release Light Measurement Year, put shoot Homosexual Isotope ^{137}Cs and ^{210}Pb dating.

Age analysis of early floodplain sediments relies almost entirely on Traditional radiocarbon dating methods (^{14}C), the best test for which it applies Quantity range is 350 ~ 10000 aBP, The uncertainty range is $\pm 40 \sim 1990$ [22]. in the west class tooth of Tagus river, transportation use put shoot sex carbon Certainly Dating the flood sediments in the basin using the annual method, new discoveries were made Flood water host want concentrated exist 6 hour Issue [23]. for Got it untie Yi A relatively complete flood sequence in the Beliya Peninsula over a long period of time, Beni - to et al(2008)search Collected district Within the domain big West foreign flow area and In the ground ocean flow area Radiocarbon ages of 79 floodplain deposits, analysis shows Ibi Leah and a half island Complete new World by Come of flood water host want concentrated exist 10750 ~ 10 240, 9550 ~ 9130, 4820 ~ 4440, 28 65 ~ 2320, 2000 ~ 1830, 960 ~ 790 and 520 ~ 290 cal. aBP 7 pieces period [24].

Optical luminescence dating (OSL) in recent years Sedimentary research in floodplains Application comparison in wide wide, high Refined Spend Sample Taste Measurement Year error Difference for 5% ~ 10% [16]. indian thar sand desert land district transport use Light release Light Law right river comic beach sediments okay Year generation point analyze, discover now That sink product Year generation for ca. 190 — 990 [18]. Guanzhong in the middle reaches of the Yellow River pot land paint water river valley land Photoluminescence measurements of two groups of flood sediments in the Huxizhuang section years, the results show that the formation ages of these two groups of deposits are 4280 ± 270 aBP and 4210 ± 280 aBP [25].

Since Walling and Lucky Use 137 Cs and 210 Pb square Law point Don't Measured the position At U.K. County Dorset River Stour and County Devon Culm River and After the floodplain sedimentation rate of the Exe River [26 - 27], this Two dating techniques are widely used in floodplains in recent decades to centuries under study of sedimentation. exist Fiji economy Wainimala river, roots according to river comic beach 137 appearing in the sedimentary section The Cs peak values were determined respectively 1954 and 1963 year time mark, and root according to time bid with deep degree relation hair Now 1954 — 1963 and After 1963, the average sedimentation rate of the floodplain was for 3. 2 cm/a around [28]. in england The middle reaches of the Tweed River, transport Use 137 Cs and 210 Pb established Merged chronological series of three floodplain sedimentary columns estimate Calculate That sink product speed rate, each sink product column refer to Show 1963 hour Target 137 Cs concentration peak value point Don't out now exist 7 ~ 8, 6 ~ 7 and 6 ~ 7 cm, root according to year generation-deep Spend relation estimate Calculate 3 deposition Column 1963. The sedimentation rate in 1994/1995 was $(1.9 \pm 0.2) \sim (2.2 \pm 0.2) \text{ k g} \cdot \text{m}^{-2} \cdot \text{a}^{-1}$; According to sedimentation column 21 0 Pb content, using the CICC model to estimate the content of three floodplain sedimentary columns in the past 100 years Average sinking product speed Rate at $2.3 \pm 0.6) \sim (4.8 \pm 0.9) \text{ k g} \cdot \text{m}^{-2} \cdot \text{a}^{-1}$ [29]. It is also transported in the Anhui section of the Yangtze River Basin in my country. Use 137 Cs and 210 Pb established modern floodplain deposits Era since 1849 sequence [30].

The remains of human activities preserved in floodplain sediments are also a way to judge floodplain product Year generation of Heavy main reason white. like exist France Llobregat Multiple flood sedimentary units are preserved in the concave walls on both sides of the river bedrock bank, two of which are mixed with plastics. These plastics mark Based on the age information recorded, it is determined that the two flood sedimentary units were formed respectively. At 1971 and During the great flood of 1982 [16].

3 APPLICATION AND SIGNIFICANCE OF MULTI-ENVIRONMENTAL INDICATORS OF FLOODPLAIN SEDIMENTATION

3.1 Particle Size analysis and Environmental Significance

Particle size analysis is an important method for floodplain sedimentation research. River Man Floodplain sediments have unique grain size characteristics and are an important tool for identifying floodplain sediments. One of the main indicators of. In the sedimentary ring of the Zhongba site in the Three Gorges reservoir area of the Yangtze River In environmental research, in order to determine Are the six suspected flood layers submerged in floodplains? Product, the particle size characteristics of the sedimentary layer and Modern floodplain in 1981 Comparing the sedimentary grain size characteristics, it was found that the average of these flood sediments particle size, analysis characteristics, particle size component, probability accumulation curve, etc. have phase similarity, and then determine this The six suspected palaeoflood layers are palaeoflood deposits. Things [14]. On floodplains, sediments Usually formed when floods flood the plain of deposition. In the early stages of abundant rainfall and floodplain development, floodplains are high The level is relatively low and may be flooded almost every year, forming a relatively continuous of floodplain deposition; in the later stages of floodplain development, as the river flooded The accretion of shoals increases, and even in areas with abundant precipitation, only relatively Only large-scale floods can inundate the floodplain to form floodplain sediments, so in Flood sediments formed on floodplains are discontinuous [31], especially in This phenomenon is more obvious on river terraces. deposited in floodplains Intermittent periods may accept sedimentation from non-flood media (e.g. Loess deposition, slope sediments, etc.) to form sedimentary discontinuities; in a suitable environment In this environment, floodplain sedimentation may also undergo pedogenesis during the hiatus period. into soil. In the vertical direction of the section, due to the discontinuous development of sedimentation, the sedimentation The particle size of the accumulation produces sudden changes, and many studies use this feature to identify ancient flood product layer. exist yellow in the river tour north Luo river should Jun part base rock canyon, ancient flood water sink product folder exist Complete new World wind become yellow Earth-Earth soil land layer Of During the period, particle size analysis showed that these ancient flood sediments were fluvial ancient floods. Sediments of water suspended matter in a high

water level retention environment, with the median particle size The diameter and average particle size are both larger than those of the overlying and underlying loess., ancient soil Big [32]. in the yellow river tour Wu Fort-Yi Sichuan gorge valley Duan, ancient flood water sink product Sandwiched between ancient soils and slope accumulation layers, these paleoflood sediments are Average particle size, median particle size, sorting coefficient and kurtosis and paleosol and slope accumulation The layers are significantly different [33].

In floodplain sedimentary profiles, coarse-grained material in sediments Flood events can also be indicated, as can changes in the thickness of sediment particles Indicates the frequency or magnitude of flooding. Upper Mississippi River Valley Research on the beach shows that if the sediment transported by the river system contains sand component, then large floodplains tend to form rivers with a larger sand component. floodplain sediments. In this case, if floodplain sediments come There is no change in the source, and the sandy sedimentary layer in the floodplain sediments can be used as a palaeoflood event. pieces of refer to Show refer to Standard [7]. exist Portugal Grapes tooth tagus river river In the study of floodplain sedimentation, it was found that if the particle size of floodplain sediment becomes thicker, it may indicate flood water frequency Rate or/and flood water powerful increase in degree Add [34]. floodplain product of grain Spend Change change also yes Draw point flood water one Yuan important basis for the layer. In the study of the Wei River and its tributaries, researchers According to the differences in grain size components in the sedimentary profile of the floodplain, the floodplain Divided into different unit layers, each unit layer indicates one sub-flood stage Section [31, 35]. On the basis of the division of flood unit layers, researchers based The positive correlation between floodplain sediment particle size and flood scale is and related sedimentological principles, it is proposed to determine the formation time of each unit layer relative flood depth 6 standards become the relative rules for judging floods important basis for the model [36].

3.2 Geochemical Analysis and its Environmental Significance

Elemental geochemical analysis in paleoflood sedimentary and environmental research get applied. Zr Lord want endow live At Contains Zr thick grain grain sink product thing, while Rb is mainly dispersed in fine-grained sediments, the Zr/Rb ratio with sediment particles Spend big Small submit show With of just Mutually close close Department [37]. exist Britain The upper reaches of the Severn River, on the 2nd 4m long silt floodplain deposit High profile application point distinguish Rate(500 μm)of Light Spectrum instrument (XRF)OK Scan to obtain the geochemical profile of the sediments, and compare the sedimentary profiles with In (Zr/Rb)in the plane and the sediment particle size, it is found that In (Zr/Rb)with particles path of increase big and increase big table bright sink product cut open In (Zr/Rb)in the surface can be by do for sink product thing grain Spend of refer to Show refer to bid, advance and Using the sedimentary column profile In (Zr/Rb)Change rebuilds 3750 flood since water remember Record [38]. micro quantity Yuan white Rb/Si ratio value right land surface weathering Ariake obvious refer to Show meaning righteousness, Rb Leave son Half path compare Large, with strong adsorption properties, easily adsorbed by clay minerals to preserve Stay in place or migrate at short distances, while Sr with a small ionic radius mainly It is taken away by surface water or groundwater in the form of free Sr [39]. exist In the study of paleoflood sedimentary discrimination at the Zhongba site of the Three Gorges of the Yangtze River, it was found that the Rb/Si ratio of the flood layer was significantly higher than that of the cultural layer. This was mainly due to the Rb ions are retained in place, while Sr ions are carried away by the flood, causing The Rb/Si ratio increases in the flood layer [14].

Contents of geochemical elements in floodplain sediments [40], deposit Form [41 - 42], spatiotemporal distribution [43 - 44] etc. are also exploring the river basin environment. Sewage dye important basis for. Based on geochemical elements in floodplain sediments Taking the study of cloth morphology as an example, in the UK Aire river, transport use five step even Continuing with the extraction method, explore discuss river comic beach sink product among things Pb, Zn, Cu, Cd four The chemical occurrence form of heavy metal elements was discovered Pb and Znmain is the combined state of iron and manganese oxides, Cu is mainly in the organic combined state, and Cd is mainly To be exchangeable [41].

3.3 Other Research Indicators and Their Environmental Significance

Microbiological fossils preserved in floodplain sediments play an important role in the study of ancient floods, such as the number of spores and pollen in the sediments. The type can indicate the nature of the sediment: in the absence of flooding, the river The stream is often surrounded by a relatively simple environment, and its plant pollen The types are limited, and the flow of water during floods will bring many species in a wide basin. Plant pollen, which increases the types of plant pollen during this period. These pollen There may also be very many and Should land district ring territory No Mutually suitable Should spore pink kind category, becoming one of the symbols of flood events 1 [45]. Ancient trees buried in certain river sediments of sudden Ran concentrated point cloth but and antiquity flood water thing pieces Relevantly, the period with high frequency of occurrence is consistent with the period of frequent floods. The relationship between paleofloods and climate change in the lower reaches of the Yangtze River since 6000 aBP In the study of this system, ancient trees buried in sedimentary layers are important for restoring ancient times in the study area. An important basis for floods [46]. The formation of peat is closely related to floods. Early Holocene sand ditch river river comic beach sink product cut open noodle hair Now May many mud carbon These peat layers are considered to be on the floodplain after the water surface emerges. The growing vegetation was buried and carbonized by sedimentation from later flood events. An interbed of sand and peat is a record of a flood event [47].

Mineral surface micromorphology is an important basis for judging sediment properties. According to reports, scanning electron microscopy analysis is used to identify the surface morphology of sediment minerals. Important methods of analysis. At the Three Gorges Zhongba Site and Yuxi Site of the Yangtze River In the identification study of floodplain sediments, electron microscopy scanning analysis was used to Compared with zircons from modern floodplain sediments and suspected ancient floodplain sediments Micromorphological characteristics, it was found that the similarity between the two is relatively high, manifesting as half Round or nearly round shape, all have the appearance of being left behind after being transported by running water over long distances. A certain degree of rounding characteristics and surface impact morphological characteristics, according to This judgment is suspected to be the flood sedimentary nature of the ancient flood layer [14, 48].

4 Application of Floodplain Sedimentation in Restoring Pale of Lood Events

Paleoflood studies related to floodplain sedimentation over the past 30 years has received widespread attention, paleofloods recorded through floodplain sediments Information analysis can reconstruct long-term basin flood sequences. long time scale untie release gas wait Change change and antiquity flood water Of between right answer close relationship, revealing extreme flood events, flood levels and flood occurrence patterns, Provide basis for the construction of major river basin projects and flood disaster prevention.

4. 1 Floodplain Sedimentation record and flood frequency

The paleoflood frequency analysis is based on paleoflood research. Water Information, and Historical Floods, measured floods form a flood sequence, and then pass Obtain flood frequency information through frequency calculation model [49]. In flood frequency analysis, the paleoflood information that needs to be obtained mainly includes: (1) Sedimentary evidence of flood occurrence and its recorded flood scale; (2) Flood sinks age of accumulation. As evidence of flood sedimentation, floodplain sedimentary units The division of layers is an important prerequisite for palaeoflood analysis. many studies Identify flood unit layers based on sedimentation characteristics and discuss one within a certain period flood water Expect times [16, 25]. like root according to sink product special levy, day Book Nakagawa A relatively continuous river in the bedrock canyon section of the upper reaches of the river Floodplain sedimentation can be divided into at least 41 flood sedimentary units, indicating ca. happened over 600 years 41 great floods [50]. Upper reaches of the Yellow River Sichuan Width The ancient flood sedimentation characteristics on the second terrace of the valley are clear and can be divided into 106 sedimentary units, indicating the last glacial period (20~18 ka) occurring 106 major floodplain events [51]. The thickness of the two sections of the Weinan section of the Weihe River is about is 5. 3m The typical high floodplain sedimentary profile can be divided into 19. level, refers to Show Got it 120 years Come of 19 times big regulation mold flood water [36]. Depend on Each flood may form new sediments on the original floodplain sediments. accumulation, raising the sedimentation elevation, only larger-scale floods will occur at the same New floodplain deposits are formed at the site, but other smaller-scale floods do not can be reached, therefore, the floodplain sedimentary record is greater than that of the previous floodplain. Floods at the sedimentary bottom elevation only reflect a part (low frequency) of ancient flood events. In humid areas, due to the suitable climate, a large number of animals Plant development may cause disturbance of flood sedimentary units, causing flood The boundaries of water unit layers are blurred or even disappear, resulting in one flood unit layer maybe several times big flood water shape become of sink Product [50]; this Outside, one Second-rate flood water process, in addition to bringing new floodplain sedimentation, it may also cause the original The erosion of floodplain sediments leads to the loss of flood unit layers [52]. because Therefore, in paleoflood research, it is best to study more rivers in the same river section. Floodplain or terrace profiles to obtain as much flood sedimentary record as possible, on the basis of root according to antiquity flood water arts study square Law and river comic beach Measurement Year technology technology to obtain the scale and age information of ancient floods, and then use the flood frequency model to calculate the flood frequency. Research shows that compared to empirical Measuring floods and calendar history flood water Group become of flood water sequence List get Worth it flood water frequency rate, the addition of paleoflood information can significantly reduce the calculation of flood frequency error [53].

4. 2. Paleoflood levels and discharges recorded by floodplain sediments

Ancient river floodplain sediments can be used to determine paleoflood levels. Here Calculate the peak discharge of ancient floods based on hydrological principles. from the river There are two methods for extracting palaeoflood levels from floodplain sediments: 1. Sowing is profitable Use the top elevation of the floodplain sediment layer to indicate the pale flood level; another one kind of Based on the central axis of the largest pebbles in flood deposits, calculations can be transported Minimum flood depth for these pebbles. Both methods require river The river section where the floodplain deposits are located is stable. The middle and upper reaches of the river The rocky river channel was relatively stable during the Holocene period, and the morphological characteristics of the river channel were relatively Relatively stable and regular, with strong corrosion resistance, small cross-sectional changes, and good water flow conditions. Stable, the error is small in the calculation of ancient flood flow, which is conducive to using ancient Deducing the peak discharge from the flood peak water level [19], Ideal for ancient flood research reach.

In the Grand Canyon, river preserved in bedrock alcoves floodplain product refer to Show of antiquity flood water position, push Calculate out hair born exist 4518 ~ 4239 aBP room of flood water regulation mold overtake Pass 5700

m³/s, send born At 2307~2 602 aBP between antiquity flood water flow quantity but overtake Pass 6 875 m³/s, And the paleo-flood level estimated based on the highest paleo-flood level indicated by sediments The flood flow is not less than 8800m³/s. French Garden River Bedrock caves preserve five flood settlements formed over the past 500 years Accumulation unit, its top surface elevation indicates three flows at 6850~ 7 100m³/s of ancient floods, two times larger than 8000 m³/s of Ancient Flood [21]. use West class tooth Tagus river antiquity flood water sink product of high process, discovery river in the stream tour remember record of most Small flood water flow quantity for 4000 ~ 4 100m³/The minimum paleoflood discharge recorded downstream of s is 13700~ 15 000m³/s [23].

Because floodplain sediments were formed when some floodwaters were deposited in these sediments Above, the height of the top layer of floodplain sediment is usually lower than the actual maximum flood Bit 0. 3~2m. To determine the difference between the surface layer of floodplain sediments and the actual The height difference between the highest flood levels is more difficult and becomes a paleoflood No in research correct Certainly sex because white. right yellow in the river tour of tune check research The study found that the pinch-out point of floodplain sedimentation is higher than the floodplain sedimentation level. Face 0. 03~1. 0m, in particular Formed during the great flood of 1994 The elevation of the advection sedimentation pinch-out point is almost the same as the elevation of the flood mark formed by the same flood. Almost consistent, at the same time compared with river comic beach sink product water flat noodle high out 0.25m, transport Flood level indicated by vanishing point elevation, calculated 1994 flood Traffic is only higher than actual remember load of flood water regulation mold Low 5%, say bright river comic beach Depositional pinch point elevations provide a better indication of paleoflood heights degree and improve the estimation accuracy of paleoflood flow [9]. in han river superior tour river Studies on valley terraces have also shown that pinch outs created by modern floods elevation push Suan Hong water The amount is twenty two 470 m³/s, with reality Measurement Worth it twenty one 700m³/s The torrent volumes are very similar.

Extreme floods can carry unusually large debris to floodplain surfaces noodle. The flood depth that transports a certain area of coarse-grained sediment can be Calculated by the following formula [7]:

$$D = 0.0001 A^{1.21} S^{-0.57} \quad (1)$$

where D is the minimum flood depth at which the largest debris can be transported, A is the intermediate axis of the cuttings (the parameter range is 50~3300 mm), S is the approximate energy slope of the debris (m · m⁻¹). on the upper mississippi river Valley, small and medium-sized branches flow (flow area noodle product Small At 368 km²)of river comic beach during flood between No often Allow easy shape become gravel stone sink product one Yuan. Knox and Daniels (2002)use this kind square Law count Calculate Got it lose transport most big gravel The lowest flood depth of the rock, the middle axis distribution takes the maximum 10 pebbles and The average central axis of the largest 5 pebbles gives the water transporting these pebbles The depths are 2. 7 and 3. 1m respectively., These two values are related to The Great Flood of 1950 water in river valley end Tree Wood Kamiliu Down of flood mark high Degree to and That Down tour 1. 4 km of USGS Hydrological Observatory remember record of most high Flood levels are very similar [7].

It is worth mentioning that some studies have used floodplain sediments to For coarse particulate matter, calculate the minimum flow rate required to transport the largest coarse particles, Then calculate the ancient flood flow. The calculation process is divided into two steps:

First calculate the flood velocity, the formula is:

$$D^3 = kv^6 \quad (2)$$

where D is the average particle size of the largest 5 pebbles, k is the normal coefficient, v is the flood velocity. the relationship between flow and velocity at the deposition point is calculated:

$$Q = ev a \quad (3)$$

In the formula, Q is the flow rate, v is the flow rate.

According to formula (2)and formula (3), the ancient flood flow can be calculated quantity. In the Three Gorges of the Yangtze River of one one class level land superior bury Tibetan have For the cemented gravel layer of 40~30 kaBP, the red flower set- Palaeoflood excess in the upper reaches of the Yangtze River around 40~30 kaBP in the ancient back section The flood flow in modern times is about 23. 8%.

4. 3 Floodplain Sedimentation and Environmental Archeology

Since the Holocene, river valleys and valley slopes have been the main focus of ancient human activities. One of the important places, the strata of human cultural sites often contain information related to ancient floods. Floodplain sedimentation and ancient flood events related to water and other sudden disaster events These events pose a challenge to the human living environment and provide a basis for Holocene sedimentation and environmental One of the hot areas of research. In the U.S Arizona Colorado River Grand Canyon, through to 1050 — 1170 AD 4 archeology legacy site Study of palaeoflood events recorded in strata explores early farmers Research on ancient flood events in terms of settlement form selection and settlement migration adapt. In the middle reaches of the Rh ðne river in France, some studies have Systematically study the distribution and accumulation of Holocene archaeological strata and ancient flood sediments accumulation situation, and explore the impact of ancient flood events on Holocene archaeological sites in the basin. Distribution effects. exist river South new village legacy site East department of Test antiquity hair dig Buried ancient flood channels from 3550 to 3400 aBP were discovered in The river channel accumulation is mainly composed of two cycles, and the lower part of each cycle is the river The bed phase is accumulated, with the middle part being flood sediments and the upper part being still water in the later stage of the floodplain. sedimentation,

indicating that abnormal flood events occurred in this area during the Xinzhai period, which Pawn timely people kind born live ring territory make It's done strict Heavy break Bad and power threaten. Against the Seahorse bridge legacy site cut open noodle of research study but show horse Qiao Liang Decline of Nagisa Culture fall yes big regulation mold flood disaster Place To. exist Guanzhong pot land On the terraces along the valley in the middle reaches of the Qishui River in the west, the Longshan Cultural Settlement covering the — Holocene flood stagnation on the cultural layer of the Huxizhuang site The sedimentary layer, this flood caused the early settlements and fields of the Longshan Culture to be submerged, while the settlements in the late Longshan Culture developed rapidly [11]. exist Located in the Guanting Basin in the upper reaches of the Yellow River, the strata of the Lajia site and surrounding rivers The terraces record the abnormal floods and earthquakes from the Yellow River that occurred in the area at that time. This natural disaster was dominated by earthquakes and was accompanied by flash floods. Natural disasters led to the destruction of the Lajia ruins, and abnormal floods in the Yellow River Gelajia ruins First civil bring Come Got it destroy top Of disaster. just yes exist this Second-rate In the mass incident, the remains of prehistoric human life and scenes of disasters were The sediment sealed by earthquakes and floods was excavated from the archaeological site. live and not yet over Complete Rotten rotten More than 4,000 Year former noodle Tiao is the oldest noodle discovered in the world so far.

5. RESPONSE OF FLOODPLAIN SEDIMENTATION TO WATERSHED ENVIRONMENTAL POLLUTION

5.1 Floodplain Sedimentation and Watershed Environmental Pollution

Strongly affected by modern human activities, a large number of toxic and harmful Heavy metal elements, radionuclides, organic pesticides and compounds enter river. Due to the large specific surface area of fine particulate matter during floods, it provides There are many adsorption sites on the surface, and pollutants tend to be adsorbed on fine particles. Materially. Systematically collect certain surface natural substances to standardize method to create various scale maps of spatial changes in surface material elements. The geochemical map is a study on regional geochemical environmental background and environmental assessment. fundamentals of research work do. river comic beach sink product yes most suitable should of land ball Chemical mapping sampling media can reflect the geochemistry of watershed elements feature. Made from surface sediments of 529 river floodplains in China Cu geochemical map and analysis using millions of river sediments across the country As a result, the geochemical map of Cu drawn has relatively large differences in the same area. The good similarity shows that floodplain sediment samples can reflect large-area elements. average score cloth regulation law. river comic beach surface layer sink product Can able by arrive Pollution from human activities, deep floodplain sediments represent industrial pre-industrial or unpolluted state of nature. through the river Floodplain surface samples Hg analysis results and deep samples Hg analysis result The distribution map of fruit ratio across the country clearly shows that the recent 50 years of industrialization mercury pollution in eastern China [4]. To sum up Place narrate, base International geochemical mapping using floodplain sediments as sampling media is an important way to understand large areas, large watershed scale environmental background and environmental pollution status An important way to evaluate the situation.

5.2 Pollution Processes and Pollution Events Recorded in Floodplain Sediments

Suspended matter that absorbs pollutants is deposited on the floodplain during floods on, on a stable, on floodplains dominated by vertical accretion, almost every Sub-floodplain floods can form new sediments on it, recording the watershed environmental pollution process. For example, in the Anhui section of the Yangtze River Basin, according to the river beach deposits column Sample 210 Pb and 137 Cs Certainly Year Knot fruit, divided analyze Got it sink product Changes in Cd content in the column profile with time, it was found that the profile Cd equal weight The changing characteristics of metal element content and the founding of New China, Reform and Opening and large-scale industrial Industry change Enter Procedure wait calendar history thing pieces base Book kiss Together [30]. have Research right South No Berg River river comic beach sink product cut open noodle Enter Line 210 Pb is set year, explored the deposition record of mercury, and the results showed that since Beginning in 1970 The deposition rate of mercury in sediments increases. in England Aire river is located On floodplains downstream of urban and industrial areas, sedimentary profiles P contains Quantity reflects Pass go more than 100 years Come flow area ring territory Sewage dye Pass Cheng: In Before 1900, there was only a weak increasing trend in phosphorus content in sediments; after 1900 later, follow With city city ized hair develop, progress enter river flowing Inorganic phosphorus increased, and the increase in phosphorus content in sediments accelerated; at the turn of the century due to improvements in sewage treatment plant technology and related environmental policies With the implementation, the phosphorus content in sediments began to decrease [40].

Pollutants produced by human activities enter water bodies and are carried by floods To the floodplain, the content of heavy metal elements in the sedimentary profile of the floodplain suddenly increase and become a natural record of pollution events in the basin. located in poland southwestern Odra river, Leg nica (wave orchid West South department city City)Copper mine District in Appeared around 1980 Cu and Pb max Produce measure, receive quilt Impact of wastewater discharge caused by heavy metal pollution, revealed in floodplain sediment profile Concentration peaks of Cu and Pb are found; in another floodplain sedimentation profile of Znhas two individual concentrated Spend peak Value: derived from superior tour of Sewage water Row put yes Causes the concentration peak at the top of the profile; the

peak at the bottom may be related to post world war ii industry hair exhibition and population dense Spend Change change have Guan [72]. Depend on At flow Early Pb - Zn mining activities in the Geul River, eastern Belgium The floodplain was gold genus Pb, Zn, Cd, etc. high pollution in. Plombières tail _ mine north noodle 1 km of river comic beach sink product cut open Face, most High levels of heavy metals are also related to mining activities in the 19th century. Off [73].

6 OUTLOOK

6. 1 Research on Floodplain Sedimentation and Climate Change

Floodplain sediments are widely distributed, with diverse sedimentary characteristics point, because floodplains and flood events are closely related, and floods and are closely related to climate change, therefore, preservation of continuous and large accumulation thickness Floodplain sedimentary records have important significance and prospects for recovering from climate change. Although previous studies have explored floodplain sedimentary records ancient flood and gas wait thing Pieces [9,18]_ , No Pass river comic beach sink product and gas Research on climate change remains to be done one Go deeper, especially at the basin scale A comprehensive comparative study of multiple floodplain sedimentary records may be more accurate accurately indicate regional climate changes and climatic events related to ancient floods pieces.

6. 2. Study on Floodplain Sedimentation Characteristics and Material Sources

The focus of research on river floodplains at home and abroad is the ancient flood problem There are few systematic studies on the sedimentary characteristics of floodplains, such as Summarize the similarities and differences of floodplain sedimentation in the upper, middle and lower reaches of the river. Differences in material composition of floodplain sediments are closely related to material sources. In the lower reaches of large river basins, floodplain sedimentation occurs on different time scales. Exploring its material sources is of scientific significance and challenge. Like flowing with the river River sediments in estuarine delta areas with common material sources on the beach can To indicate the crossing event of a large river; Some specific pollutants in floodplains Pollutants are closely related to human activities in different periods of the basin, such as carbon pellets produced by coal use., DDT and other pesticide residues things etc.

6. 3 Outlook

China has many rivers, complex plateau and mountain topography, and wait many Sample, River and floodplain sediments under different climate and topographic conditions have many Variety characteristics. Regardless of modern floodplain sedimentation and environment, or from There are many research objects and perspectives on ancient river floodplain deposition, so Therefore, my country's floodplain sedimentation and environmental research has broad prospects. Currently I The main floodplain sedimentation and environmental research in China is mainly concentrated in the middle of the Yangtze River. river basin, ancient floodplains in the Yellow River Basin (floodplains on valley slopes), but There are relatively few studies on floodplain sedimentation and environment in the lower reaches of large rivers. The use of floodplain sediments to study environmental pollution processes and pollution events is also Very attractive. Floodplain sediments are reservoirs of pollutants and are responsible for Contaminant migration in floodplain sediments, related research on transformation and It is necessary to learn from relevant environmental chemistry methods to carry out further further research.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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