

Table 1. The twenty-five most significant amber deposits and their evolutionary phases¹

<i>Amber, figure</i>	<i>Locality</i>	<i>Strata, age</i> ¹	<i>Resin source</i>	<i>Habitat</i>	<i>Significance</i>	<i>References</i>
PHASE 4						
1. East African Copal	Tanzania, Sambava, northeastern Madagascar	Subfossil; alluvium (0.7–0.05 Ma)	<i>Hymenaea verrucosa</i> (Fabaceae)	Subtropical mangrove forest	Combination of recently extinct and extant congeneric species; historical structure of modern tropical ecosystems	Schlüter and Gnie-linski, 1980; Penney and Preziosi, 2010; Bisulca et al., 2012
2. Colombian Copal	Colombia	Subfossil; alluvium (2.5–0.2 Ma)	<i>Hymenaea coubaril</i> (Fabaceae)	Tropical rainforest	Extant and extinct species provide examples of microevolutionary processes; historical structure of modern tropical ecosystems	Martínez-Delclòs et al., 2004; Penney and Preziosi, 2010; Penney et al., 2013
3. Cape York Amber	Cape York Peninsula, Northern Queensland, Australia	Beach deposits, unknown source: Miocene, based on inclusions (5–23 Ma)	<i>Agathis</i> , possibly <i>robusta</i> (Araucariaceae)	Subtropical Rainforest	High potential for resolving Australian, Indonesian, Melanesian and Micronesian Neogene biogeographical relationships	Bickel, 2009; Hand et al., 2010
4. Amazonian Amber	Tamshiyacu, Santiago River, Amazonas Department, Peru	Pebas Fm.; late–early Miocene: Tortonian–Burdigalian (10–18 Ma)	Undetermined angiosperm	Tropical rainforest	Neogene data for rainforest biota of Western Amazon Basin; insight into evolutionary biology and biogeography	Antoine et al. 2006
5. Mexican Amber	San Cristobal de las Casas; Chiapas, Mexico	Simojovel Fm.; middle–early Miocene: Serravallian–Burdigalian (13–19 Ma)	<i>Hymenaea mexicana</i> (Fabaceae)	Subtropical mangrove and dry lowland forest	Mangrove forest with similar ecology and close arthropod relatives exists nearby on the Pacific coast today, providing comparisons of long-term ecological change	Durham and Hurd, 1957; Santiago-Blay and Poinar, 1993; Solórzano-Kraemer, 2010

6. Dominican Amber [Figs. 2-1, 2-2, 2-4, 2-8; 6; 8-4, 8-5, 8-12]	Santiago Province, Cordillera Septentrional; Dominican Republic	La Toca Fm.; early Miocene: Burdigalian (16–18 Ma)	<i>Hymenaea protera</i> (Fabaceae)	Tropical moist lowland forest	Second most diverse amber deposit after Baltic Amber; provides a case-study for investigating faunal bias in the fossil record; fertile ground for testing biogeographical hypotheses	Hueber and Langenheim, 1986; Poinar and Singer, 1990; Henwood, 1992a; Penney, 2010; Poinar, 2010; Penney et al., 2012a
7. Bitterfeld Amber	Bitterfeld, Saxony-Anhalt, Germany	Cottbus Fm., “Glimmersand”; late Oligocene: Chattian (23.5–25.5 Ma)	<i>Picea, Pinus</i> (Pinaceae)	Humid warm-temperate deciduous forest	Existence of same insect species 15 million-year older Baltic Amber perhaps indicates high evolutionary longevity of insect taxa; redeposited Baltic amber	Rikkinen and Poinar, 2000; Dunlop, 2010; Sodhi et al., 2013
8. Rovno Amber	Rovno, Mezhyrich, Rovno and Zhitomir regions; Ukraine	Mezhygorje Fm.; late Eocene: Bartonian: (41.2–37.8 Ma)	<i>Pinus succinifera</i> (Pinaceae) ²	Warm temperate to subtropical dry forest	Site shares many species with the five million-year earlier Baltic Amber; diverse ants and wasps display early insect sociality	Perkovski et al. 2010
9. Baltic Amber ³ [Figs. 5; 8-1–8-3, 8-7–8-11]	Eastern Baltic Sea Region; Mecklenberg–West Pomerania, Germany; Gdansk Poland; Kaliningrad, Russia	Prussian Fm.; late Eocene: Lutetian (37–34 Ma; some perhaps as old as 44.4 Ma)	<i>Pinus succinifera</i> (Pinaceae); or possibly <i>Pseudolarix</i> sp ²	Humid, warm temperate to subtropical forest and woodland	Most diverse fossil deposit, with 3109 recorded arthropod species in 2010; several extinct taxa were found here before they were recognized as having extant descendants; significant plant and vertebrate representatives, especially lizards	Grimaldi et al., 1994; Ritzkowski, 1997; Weitschat and Wichard 2002, 2010; Koller et al., 2005; Henderickx et al., 2006; Perreau and Tafforeau, 2011; Dunlop et al., 2012
10. Fushun Amber	Wanghua District Fushun Prefecture Liaoning Province, China	Guchengzi Fm.; middle Eocene: Lutetian (47.8–41.2 Ma)	<i>Metasequoia?</i> (Cupressaceae)	Subtropical conifer-hardwood forest	Major deposit in eastern Asia that provides biogeographic & phylogenetic context for origin of the modern East Asian insect fauna	Zhang and Hong, 1999; Hong, 2002; Wang et al., 2010; Wang et al., 2011
11. Cambay Amber	Anand District, Gujarat State, India	Cambay Shale Fm.; early Eocene: Ypresian (52–50 Ma)	Dipterocarpaceae	Tropical everwet forest	Diverse insect assemblage that addresses taxonomic and biogeographic affinities of organisms during India’s 95 m.y. isolation	Alimohammadian et al., 2005; Rust et al., 2010; Penney et al., 2012b

12. Oise Amber	Creil (= Le Quesnoy); Oise; France	“Argiles à lignite du Soissonnais”; early Eocene: Ypresian (53 Ma)	<i>Aulacoxylon sparnacense</i> (Combretaceae)	Warm-temperate deciduous forest	Although of slightly younger age than Baltic Amber, little faunal similarity; affinities with modern taxa in tropical environments	Brasero et al., 2009; Nel and Brasero, 2010
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PHASE 3

13. Hell Creek Amber	Harding Co., South Dakota, USA	Hell Creek Fm. Late Cretaceous: late Maastrichtian (67–66 Ma)	[Not reported]	?Riparian woodland	Well-documented deposit that could illuminate culprits of plant-insect associations across the K-Pg crisis in the Williston Basin	DePalma et al., 2010
14. Canadian Amber	Grassy Lake (primary source), Alberta and Cedar Lake, Manitoba Canada	Foremost Fm.; Late Cretaceous: Campanian (79–78 Ma)	<i>Parataxodium</i> sp. (Cupressaceae)	Coastal wetland and woodland	Diverse assemblage abundant in mites and aphids; hemipterans with five, extinct, phytophagous, late Mesozoic families, indicating many host (?conifer) associations	Carpenter et al., 1937; McAlpine and Martin, 1969; Pike, 1994, Borkent, 1995; McKellar and Wolfe, 2010
15. New Jersey Amber	New Brunswick, Sayreville, South Amboy, Middlesex County, New Jersey	Raritan and Magothy Fms.; Late Cretaceous: Turonian (88 Ma)	<i>Juniperus hypnoides</i> (Cupressaceae)	Coastal swamp forest	Crucial for documenting early-angiosperm flowers and pollinators; very early ants; diverse insects with extinct, family-level lineages; earliest land tardigrades	Grimaldi et al. 1994; Borkent, 1995, 2000; Grimaldi et al., 2000a; 2000a; Grimaldi and Nascimbene 2010
16. Ethiopian Amber	Semien Shewa, Amhara Province, Ethiopia	Debre Libanos Sandstone; Late Cretaceous: Cenomanian (95–93 Ma)	Unknown gymnosperm; but not Cheirolepidiaceae	Subtropical forest	Important deposit for determining mid-Cretaceous history of East African Gondwanan evolutionary history and biogeography	Schmidt et al., 2010
17. Charentes Amber ³ [Figs. 4-15 –4.18; 8-6]	Aix Île, Charentes Dist., Angoulême Dept., France	Units A1g–A1s13 unnamed formation: uppermost Albian/lowermost Cenomanian (~ 101 Ma)	<i>Agathoxylon</i> (Araucariaceae) and possibly <i>Frenelopsis</i> (Cheirolepidiaceae)	Subtropical to warm-temperate forest	Perhaps the richest Mesozoic deposit of microorganisms; fauna transitional between older Mesozoic forms that became extinct and newer lineages of today	Perrichot, 2005; Schmidt et al., 2008; Lak et al., 2008a, 2008b, 2009; Girard et al., 2008, 2009; Perrichot et al., 2010

18. Burmese Amber	Hukawng Valley, Myitkyina and Upper Chindwin Districts, Kachin State, Myanmar	[unnamed formation]; latest Early Cretaceous: Albian (~ 103 Ma – earliest Late Cretaceous (~ 100 Ma)	cf. <i>Agathis</i> (Araucariaceae)	Tropical forest	Represents a transitional arthropod fauna between older mid-Mesozoic lineages that became extinct (e.g. last lophioneurid) and earliest occurrences of modern lineages (e.g., earliest bee)	Grimaldi et al. 2002, 2005a, 2005b; Koteja, 2004; Grimaldi and Ross, 2004; Poinar and Danforth, 2006; Ross et al., 2010
19. Álava Amber [Figs. 2-9, 2-10; 4-10 –4.14]	Peñacerrada, El Soplao, La Hoya, Basque-Cantabrian Basin, Álava Province, Spain	Escucha Fm.; Early Cretaceous: Albian (113–101 Ma)	<i>Frenelopsis</i> sp. (Cheirolepidiaceae); possibly Araucariaceae	Humid warm -temperate coniferous forest with rich, xeric understory	A diverse biota dominated by Diptera and Hymenoptera; many showing substantial fungal degradation of bioinclusions; pollinator relationships with gymnosperm hosts	Alonso et al., 2000; Martín-González, et al. 2009; Peñalver et al., et al., 2010; Peñalver and Grimaldi, 2010; Speranza et al., 2010; Peñalver et al., 2012
20. Lebanese Amber	Hammana, Jouar Sous and 14 other sites; North Lebanon, Mount Lebanon & South Lebanon & Governates	Chouf Sandstone Fm. and Abeih Fm.: lower Aptian–upper Barremian (118–135 Ma)	<i>Agathoxylon</i> (Araucariaceae), <i>Protocarpoxyton</i> (Cheirolepidiaceae)	Subtropical mesic forest	Earliest, well-preserved, diverse amber biota in the fossil record; records phytophagous arthropod taxa on gymnosperm hosts that become extinct during the mid Cretaceous; many extinct families	Schlee and Dietrich, 1970; Azar, 1997; Dalla Vecchia and Chiappe, 2002; Koteja and Azar, 2008; Azar et al., 2010

PHASE 2

21. Khlong Min Amber [Fig. 4-9]	Khlong Thom District; Krabi Province, Thailand	Khlong Min Fm.; Middle–Late Jurassic (174–145 Ma)	<i>Agathoxylon</i> (Araucariaceae)	Warm-temperate moist forest	Best of three Jurassic amber deposits worldwide with potential of sufficiently large clasts that would reveal macro-organisms	Philippe et al., 2005; also see Azar et al. 2010, for eastern Mediterranean sites
22. Dolomites Amber ³ [Fig. 4-1 –4-6]	Cortina, Dolomite Alps, Belluno Province, Italy	Heiligkreuz Fm.; Late Triassic: late Carnian (~ 230 Ma)	Cheirolepidiaceae, such as <i>Brachyphyllum</i> or <i>Pagiophyllum</i>	Xeric subtropical woodland	Oldest amber deposit with preserved macroscopic organisms (mites and insects) and a well-preserved, associated microbiota	Roghi et al., 2006; Schmidt et al., 2006, 2012
23. Chinle Amber	Petrified Forest National Park, Arizona, USA	Chinle Fm.; Late Triassic: late Carnian (~ 230 Ma)	Probably <i>Agathoxylon arizonicum</i> (Araucariaceae)	Xeric subtropical woodland	Only pre-Cretaceous amber in North America; high probability of capturing Late Triassic arthropods for comparison to Newark Basin and Dolomites amber	Litwin and Ash, 1991

PHASE 1

24. Herrin Amber ⁴ [Fig. 3-1–3-2, 3-4]	Shawneetown, Illinois Basin, Illinois, USA	Carbondale Fm.; Middle Pennsylvanian: Moscovian (~ 306 Ma)	<i>Pachytesta illinoense</i> (Medullosaceae)	Mixed coastal swamp forest	Although resin rodlets are small, they have the potential for preserving micro-organisms and arthropods as small as mites.	Kosanke and Harrison, 1957; Lyons et al., 1982; van Bergen et al., 1995
25. Trade-water Amber [Fig. 3-6]	Locality not reported; Illinois, USA	Tradewater Fm.; Early Pennsylvanian: Bashkirian (~ 320 Ma)	Unknown; possibly a basal gymnosperm	Not reported	Only Paleozoic amber deposit with substantively sized amber casts and potential for trapping organisms a few mm in size	Bray and Anderson, 2009

¹In chronological order, from youngest (top) to oldest (bottom).

²The affinities of Baltic Amber are controversial. *Pinus succinifera* is most likely (Weitschat and Wichard, 2010); others are kauri *Agathis* (Araucariaceae, cedar *Cedrus* (Cupressaceae), umbrella pine *Sciadopitys* (Sciadopityaceae) and golden larch *Pseudolarix* (Anderson and LePage, 1995)

³Includes nearby, penecontemporaneous amber occurrences.

⁴Figure 3-3 and 3-5 in this contribution are resin rodlets from the Danville Coal of the Illinois Basin, of Late Pennsylvanian (Kasimovian) age.