Did pre-Columbian populations of the Amazonian biome reach carrying capacity during the Late Holocene?

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Abstract

The increasingly better-known archaeological record of the Amazon basin, the Orinoco basin, and the Guianas both questions the long-standing premise of a pristine tropical rainforest environment and also provides evidence for major biome-scale cultural and technological transitions prior to European colonisation. Associated changes in pre-Columbian human population size and density, however, are poorly known and often estimated on the basis of unreliable assumptions and guesswork. Drawing on recent developments in the aggregate analysis of large radiocarbon databases, here we present and examine different proxies for relative population change between 1050 BC and AD 1500 within this broad region. By using a robust model-testing approach, our analyses document that the growth of pre-Columbian human population over the 1,700 years prior to European colonisation adheres to a logistic model of demographic growth. This suggests that, at an aggregate level, these pre-Columbian populations had likely reached carrying capacity (however high) before the onset of European colonisation. Our analyses also demonstrate that this aggregate scenario shows considerable variability when projected geographically, which bears on our overall understanding of the resilience of past human food procurement strategies. Lastly, our results provide important insights into pre-Columbian demographic trends and offer novel perspectives on demic expansions, language diversification, and subsistence intensification in the Amazonian biome during the late Holocene.

Keywords: Amazonian biome, Amazonian archaeology, Palaeodemography, Summed Calibrated Probability Distributions, late Holocene

In the broad lowland region of the Amazon basin, the Orinoco, and the Guianas, the late Holocene is widely regarded as a crucial timeframe for the amplification of anthropic landscape transformations [1–3]; the emergence of long-lived and widespread archaeological traditions [4]; and the diversification of important indigenous language families [5–7]. These and other processes, including increased social integration [8] and agricultural intensification [9–13], cannot be explained through appeal to mechanistic cause and effect nor detached from historical contingency. Indeed, archaeological research shows that the relationship between language families and specific archaeological material culture traditions is complex and multidirectional, likely overlapping only partially over space and time [5]. It also documents multiple forms of niche construction that, in aggregate, cannot be attributed to a single cultural determinant, however defined. All such processes, however, are *per force* demographically-sensitive phenomena: simply put, the size of human populations bears on how novel human niches are formed, how traditions of material culture evolve, why people intensify food production, and how new languages diversify within a language family. Hence, aside from relying on archaeological, environmental, or linguistic evidence to ascertain or infer an onset for these processes (which often limits us to "as early as" narratives), we argue that an appreciation of underlying demographic trends is essential to assess how they likely unfolded in pre-Columbian history.

Although the rise, expansion, and demise of South American native populations from the time of European colonisation has played a pivotal role in scholarly discussions over several decades [14–19], our understanding of pre-Columbian demographic fluctuation for the Amazonian biome is at best limited. A recent approach to infer prehistoric demographic change is the use of time-series based on the summed probability distribution (SPD) of calibrated radiocarbon dates associated with archaeological evidence. SPD-based studies assume that the frequency of calibrated radiocarbon dates over time can be examined as a proxy of relative change in population size. SPD-based studies, therefore, quantify the overall probability of distinctive occupation events that took place in a defined geography as a proxy for relative population fluctuation. In the Amazon basin, a number of studies have explored putative links between SPDs and the formation of anthropic landscapes, relationships between palaeoecology and broad spatio-temporal patterns of human occupation, and the resilience of pre-Columbian livelihoods [12,20,21]. These studies, however, have either relied on very small datasets or eschewed explicit model-testing to assess whether fluctuations in the constructed SPD time series constitute demographic shifts worthy of attention [22]. While this is partly an outcome of a lower intensity of archaeological research in the region, resulting in fewer and heterogeneously distributed radiocarbon dates compared to other world regions, the importance of employing large datasets and a model-testing approach [23–26] is underscored by a more recent study [27] that identifies links between multiple phases of middle Holocene demographic downturn and high climatic variability in South America. This study demonstrates that following a middle Holocene demographic nadir, sharp population growth in South America started around the 4th millennium BP, a finding that is consonant with suggestions that between 5.5 and 2.0 ka BP South America witnessed exponential human population growth [28].

Did the pre-Columbian human population of the humid tropical lowlands of northern South America continue to grow (exponentially) until the onset of European colonisation in the 16th century AD? This is an important implicit assumption of the recent wave of Amazonian research that has sought to reject a determining role for so-called environmental limitations to population growth [1,29]. However, by and large it remains an empirically underexamined assumption with significant implications for reconstructions of pre-Columbian cultural history. Here we approach this question through the analysis and discussion of an SPD-based demographic proxy of relative population change during the late pre-Columbian period, 3000-500 BP (i.e. 1050 BC to AD 1500; we use calibrated BC/AD instead of BP). Model testing and derived measures, based on nearly 1,400 radiocarbon dates associated with archaeological remains, reveal demographic patterns during the Late Holocene that are highly distinctive and have important implications for evaluating competing accounts of pre-Columbian cultural history. The trends we document permit discussing whether exponential population growth prevailed into the millennia immediately prior to European colonisation and also expand our understanding of the demographic dimension of multiple pre-Columbian phenomena, including linguistic diversification, human-induced environmental impact, and the resilience of pre-Columbian lifeways.

Materials and Methods

We compiled a database of georeferenced radiocarbon dates (hereafter RAmazon, see ***Supplementary Material.3***) from an exhaustive and ongoing survey of the extant grey and academic literature in the Amazonian biome. This survey was initiated by the lead author over 15 years ago and has been supported by the UCL Institute of Archaeology since 2011. While unlikely to represent all archaeological radiocarbon dates obtained since the availability of radiometric dating, we are confident that RAmazon represents the vast majority of them. As is becoming a standard hygiene protocol in the aggregate analysis of radiocarbon data [23,24], we withheld from our analyses radiocarbon dates whose errors exceed ±200 years, as well as dates whose calibrated age range extend into the present at 2σ. Almost 2,000 usable radiocarbon determinations, spanning from approximately 14 ka ^{14}C BP to the present, resulted from these efforts. Here, we focus on the dates that fall within the final three millennia (younger than 1050 BC) in a broad region (***Figure 1a***) defined by the major western tributaries of the Amazon basin, the Orinoco basin, and the Guianas. This extensive region is regarded as the geographical setting for the diversification of Arawakan (Maipurean) languages, as indexed by the spatial distribution of distinctive modelled-incised archaeological pottery and extant speakers of these languages [6]. Two other similarly extensive archaeological ceramic traditions -the Amazonian Polychrome tradition and Incised-Punctate tradition/Arauquinoid series- are considered indexical of the expansion of Tupi-Guarani and Carib languages starting in the late first to early second millennium AD [15]. For our period of interest (1000 BC – AD 1500), the RAmazon database includes 1,393 usable radiocarbon determinations from 375 separate archaeological sites. Of these, 46 sites (185 dates, concentrated in modern French Guiana) cannot be accurately georeferenced based on published data: below we exclude these sites from our spatial tests but include the dates in other graphic summaries.

Calibration, aggregation, and analysis of this dataset were carried out in R using the package '*rcarbon'* version 1.3.1 [30]. The code for reproducing our analyses accompanies this manuscript (see ***SM.2)***. For calibration we followed recommendations for tropical settings laid out by Marsh et al. [31] and employed a 50/50 mix of IntCal13 [32] and SHCal13 [33], with combined uncertainties calculated in quadrature. In order to avoid skewing the probability of specific calendar date ranges and creating abrupt spikes in the summed probability distributions at points where the calibration curve is steep [24,34] we have not normalised the post-calibration probability densities. To facilitate a broad understanding of the structure of this dataset, we visualise the calibrated dates employing two complementary techniques: Summed Calibrated Probability Distributions (SPDs) and Composite Kernel Density Estimates (CKDEs). In the case of the former (***Figure 1b, Figure 2a***), and in order to examine expectations derived from prior research [20,27,28], we attempted to fit our SPD time-series to exponential (reflecting population growth with unlimited resources) and logistic (reflecting a decreasing rate of population growth as resources become scarce) models. To this end, we simulated and back-calibrated *n* random dates, where *n* is the number of bins, before summing their calibrated probability distributions. This procedure was repeated 999 times to generate a theoretical confidence envelope for the null model from the distribution of simulated SPDs, permitting both comparison with the empirical SPD [25,30] and identification of demographic shifts that, by exceeding the confidence envelope, indicate population upturns and downturns beyond the expectations of the model [23,24]. We also deployed CKDEs, a more recent alternative to SPDs [35,36], that advantageously minimise calibration "noise" and provides complementary estimates of sampling- and calibration-derived uncertainty over time. We also derived geometric growth rate estimates from the CKDEs (***Figure 1*c** and ***1d***). The SPD, CDKE, and estimated growth rates were all produced with a running mean, kernel bandwidth, or backsight of 50 years. These summary measures of the dataset structure are shown in ***Figure 1a-d*** and ***Figure 2a***.

Model fitting of SPDs and CKDEs provide only aggregate measures of dataset structure that do not take into consideration variation in the spatial density of ^{14}C dates. Given the highly uneven geographical distribution of our dataset (***Figure 1a***), there is a high likelihood that certain subsets of the data will depart more markedly from other spatially proximate and chronologically contemporary subsets. Grouping radiocarbon data into marked subsets for use in *non-parametric permutation testing* of the marks with Monte Carlo methods [27,37] is a frequently-used solution to test for the effects of uneven geographic structure. A major point of contention with this approach, however, is the representativity and true meaning of these subsets of radiocarbon dates in archaeological terms and, hence, their validity as *a priori* units of analysis [22,24]. For instance, subsets of dates established on the basis of specific archaeological parameters (e.g. subsistence type, a given archaeological ceramic style) create spatial groupings that are relevant to specific time slices but potentially entirely irrelevant to prior or later time slices and, hence, to overall palaeodemographic processes at regional scale. To circumvent the need to manually partition RAmazon, we employed *spatial permutation testing* (***Figure 2b, Figure SM.1***) under a null assumption of homogeneous growth [38,39]. We proceeded by shuffling date locations in the place of bins. We permuted 10,000 times to ensure robust results. In addition to the calibration and binning procedure, we relied on an additional free parameter whose final value we arrived at through multiple sensitivity analyses: the bandwidth size for deriving local growth models. We tested seven ranges from 50-600 km, increasing in 100 km intervals for each above 100 km. The shortest ranges represent extremely small areas in the context of the study region as a whole, while the largest verges on half the median inter-site distance in the RAmazon dataset. We found that a mid-range spatial bandwidth of 250 km represents an acceptable balance between the distribution of the data and the goal of studying broad-scale patterns in a study region of this size. This procedure enabled us to investigate differences in growth patterns between adjoining 100-year blocks, which we label A to Y (i.e. 200-year time slices, see Weninger et al. [34]), for a total of twenty-four comparisons. Following Crema et al. [38], we report q-values alongside p-values to detect *hot* (*cold*) spots*, i.e.* locations where the observed local growth rate is *higher* (*lower*) than the randomised set, while guarding against incorrectly rejecting or failing the null hypothesis of growth (see ***SM.1***).

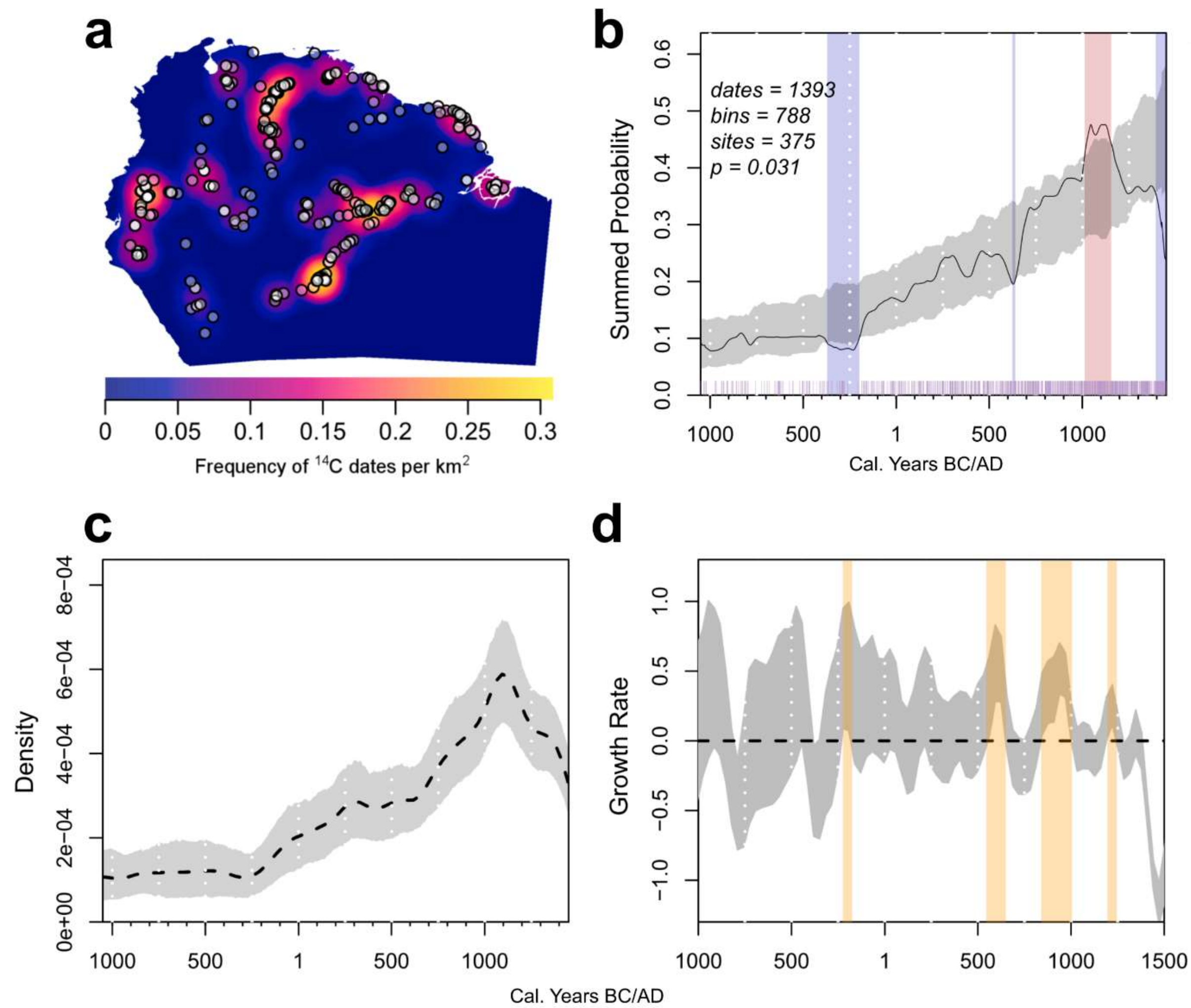

Figure **1: Summary of ^{14}C record for the study region**. a) Geographical distribution of all radiometric dates employed in this study. b) The late pre-Columbian 14C record fitted to a global exponential model, with a significance envelope derived from 1,000 Monte Carlo simulations. Note globally statistically-significant departures (p=0.0031) from the null hypothesis of exponential population growth produced by locally significant departures around 400-300 BC and AD 1000-1200. The downturn around 1400 AD is an edge effect. c) Bootstrapped composite kernel density estimate and, d) first derivative (rate of change) with confidence intervals of the bootstrapped composite kernel density estimate, identifying four uneven phases of rapid pre-Columbian population growth starting around 300 BC.

Results and Discussion

Our results offer novel insights and comparative information on pre-Columbian human population growth rates in the Amazonian biome during the late Holocene. At first glance, the SPD between 1050 BC – AD 1500 (**Figure 1b**) fits into the overall pattern of Late Holocene exponential demographic growth suggested by prior research [27,28]. However, model testing also reveals a statistically-significant (p = 0.031) departure from the fitted exponential model. Our CKDE (**Figure *1d***), in turn, identifies up to four potential periods of relatively rapid population growth starting around 300 BC in the aggregate dataset, an observation that is consistent with a previously-documented "stepped" pattern of late Holocene population growth [20]. We hypothesised that the most persistent significant departure (at 95% confidence) from the exponential model marks a potential demographic regime shift, and, on the basis of the CKDE curve, we tested a composite exponential-logistic model with a breakpoint at 2200 cal BP (or its BC/AD equivalent). The evident fit (***Figure 2*a**), which controls for the majority of late Holocene variation in our demographic proxy, suggests population growth in the Amazonian biome was not fully exponential during the last 1700 years before European colonisation. Rather, our population proxy adheres much more closely to a logistic curve characterised by a) overall rapid population growth until c. 1200 AD, and b) overshoot and stabilisation at carrying capacity during the final centuries before European colonisation.

Given that, in aggregate, the logistic model is largely adhered to, all things being equal we might expect few statistically significant deviations in local growth rates. ***Figure 2b***, however, highlights spatially heterogenous demographic growth patterns in a total of twenty-four comparisons. We refer to these comparisons as time slices using letters from A to Y. Each of these refers to a comparison of growth rates between adjacent centennial-scale blocks rather than a period of a century. For example, time slice F-G compares change in growth rates between 550-450 BC (block F) and 450-350 BC (block G). For ease of writing, we employ the median dates of each set of blocks when reporting change over time, i.e. we refer to time slice F-G simply as 500-400 BC.

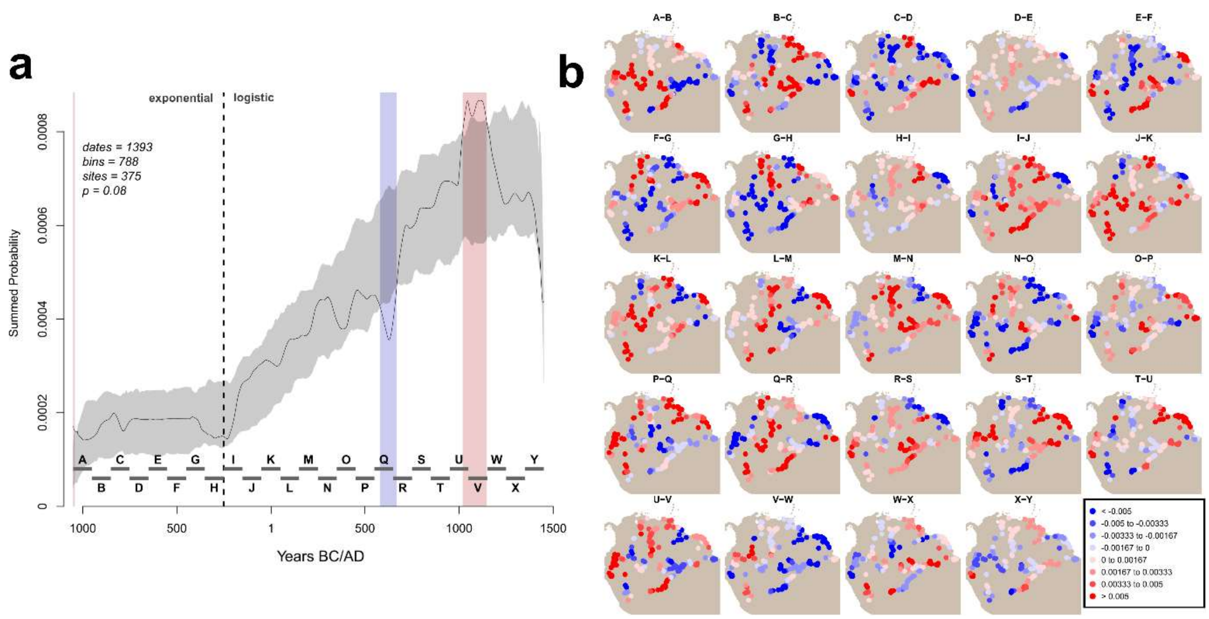

Figure 2. a) The late pre-Columbian ^{14}C record fitted to exponential (1000 BC-300 BC) and logistic models (300 BC- AD 1500), with a significance envelope derived from 1,000 Monte Carlo simulations. Note statistically-significant departures from the null hypothesis of logistic population growth around AD 600 and AD 1000-

1200. b) Raw growth rates (dimensionless) based on 10,000 spatial permutations, comparing local growth rates between adjoining 100-year (letters A-Y). General adherence to a logistic model in the global test can be explained with recourse to spatially-variable growth rates counterbalancing each other over time.

Comparison of ***Figures 1b, 2a*** and ***2b*** reveals that significant biome-wide population decline observed around ~400-200 BC in the SPD masks subregions within the biome that witnessed significant population growth (slice G-H. Significant to $p < 0.05$, see ***Figure*** **SM.1**). If we follow these through the spatially-represented time series, it would appear that they "consolidate" into a global pattern of growth in the final two centuries of the first millennium BC (slice I-J), a pattern sufficiently robust to extend into western Amazonia by AD 1 (slice J-K). This pattern provides further support for our claim that a demographic regime shift ensues and, importantly, identifies raw population growth earlier in the middle Orinoco and the northern Guianas (slice H-I). For this time range, archaeological artefactual evidence from the Orinoco basin, the southwestern, middle, central, and lower Amazon, as well as the upper Ucayali basin, record the debut of occupations characterised by pottery variously described as Barrancoid-Saladoid (outside of Amazonia), or associated with the Incised-rim tradition (within the Amazon basin). This widespread tradition is generally associated with the diversification of Arawakan languages [6,8,40]. Contrary to received accounts [15], the earlier growth northeast of the Amazon basin (***Figure 2b***, slices I-J and J-K) suggests that this demographic pattern may originate in the middle Orinoco and Guianas region and expand south and west along major waterways into the Amazon basin. Irrespective of whether a long or a short chronology for the ceramic Barrancoid series is adopted [41], and not discounting some early archaeological sites that can be associated stylistically [42], the demographic signal is consistent with an *expansion* of Arawak speaking fisher/root cropping societies [6] into the Amazon basin during the early centuries of the first millennium AD. P-significant plots starting at slice G-H (400-300 BC) can be argued to signal the beginning of an Arawakan expansion, while p-significant areas in J-K and K-L may be further florescence of this phenomenon (***Figure SM.1***). The fact that, in aggregate, our demographic signal never overshoots the expectations of the logistic model can be interpreted as empirical evidence that populations never exceeded carrying capacity. We argue that this better supports a "pull" model of population expansion [43], one characterised by "budding off" of splinter groups, than a "push" model of Arawakan expansion, the latter instigated by population pressure under scarce landed resources [15]. We also argue that it contradicts a "strong" version of the "trade and exchange" hypothesis [8], which we understand would presuppose the presence of significantly large pre-existing populations.

Our logistic model test (***Figure 2a***) shows a clear and steep population upturn from AD 100-300 (***Figure 2b***, slices K-L to M-N) to AD 500-600, when a statistically-significant downturn (assessed against the logistic model) is observed (***Figure 2b***, slices P-Q to Q-R). Note that this downturn is similarly recorded as significant in our exponential model test (**Figure 1b**). For this time range, archaeological artefactual evidence suggests the continuing evolution and inter-regional cross fertilisation of groups using modelled-incised pottery in eastern Amazonia (consonant with a "weak" version of the "trade and exchange" hypothesis [8]), alongside increasingly more frequent formation of small expanses of Amazonian dark earths. Geographically (***Figure 2b***), this period is marked by regionally heterogenous growth rates, with a significant hot spot in the coastal Guianas. While populations are undoubtedly growing over the course of the early half of the first millennium AD, the empirical SPD never exceeds the confidence envelope, which again argues against suggestions of population reaching carrying capacity. The downturn in our SPD towards AD 500-600 appears to be a function on an overall reduction in the rate of demographic growth in the central and lower Amazon, as well as along the far western part of our domain (slices P-Q & Q-R). This slowdown, however, appears reversed in the Guianas, Madeira basin and, possibly, the Orinoco basin. This contrast not only emphasises how non-spatial aggregate measures on a biome-wide scale can be misleading, but also offers a demographic perspective on the initial period of formation of Amazonian dark earths in eastern Amazonia: these seem to form over a period of demographically expanding populations that is punctuated by a marked but short-lived deceleration in regional growth rates.

Our logistic model test (***Figure 2*a**) highlights continued and sharp population growth starting from ~600 AD and reaching up to AD 1200. Importantly (slice Q-R), both the middle Orinoco and the upper Madeira show high grow rates before the central and lower Amazon, which records a lagged significant growth thereafter (slice R-S). For the first time in the time series, and in contrast to the first half of the first millennium AD, our SPD briefly exceeds the confidence envelope at the beginning of the second millennium AD before stabilising (slices V-W to W-X) at a lower ceiling (***Figures 1b, 2a***). At an aggregate level, we argue this can be interpreted as the reversal of a brisk pre-Columbian demographic expansion that stabilised at carrying capacity at least three centuries prior to European colonisation. Examined from the point of view of the archaeological record, it is relevant to highlight that the largest expanses of Amazonian dark earths often contain higher frequencies of artefacts associated with human occupations of this period [5]. This suggests, then, that the overall peak of human activity leading to the formation of large expanses of Amazonian dark earths takes place in the centuries around 1000 AD [44,45]. It is also worthy of note that this period epitomises the expansion of both Arauquinoid/Incised-punctuate ceramic complexes (which are often associated with Carib languages) and pottery of the Amazonian Polychrome tradition (which in western Amazonia can be associated with Tupi-Guarani languages): both reach their apogee early during the second millennium

AD. That population growth in the Madeira region accelerates earlier than the middle Amazon can lend support to suggestions of a southwestern origin for Amazonian Polychrome tradition groups [46], although testing this hypothesis exceeds the scope of this paper. For the same overall period (slices Q-R to U-V), a sharp upwards shift in population growth rates is observed in the westernmost portion of the Amazon basin, which is consistent with an East to West expansion of Amazonian Polychrome tradition people [47,48]. Similarly, the earlier increase in growth rates in the Guianas and Orinoco is consistent with Arauquinoid/Incised-Punctuate occupations, associated with Carib speaking communities, originating in the Middle Orinoco. This suggest fairly late and parallel processes of linguistic diversification for separate language communities (Tupi-Guarani stock; Carib). In broad terms, the subsequent period (AD 1200-1500) is characterised by a slowdown in biome-wide population growth occupying the last two to three centuries before AD 1500, which in aggregate suggests a stable population at carrying capacity leading up to the times of early European exploration (but note some regions witnessed significant population growth, see ***Figure*** **SM.1**). The sharp final drop in our SPD proxy is likely to be an outcome of archaeological sampling biases [22], compounded by demographic decline and dispersal as Europeans enter the region.

Conclusion

Our large sample size and use of Monte Carlo simulation methods makes us confident that the results presented above represent a first-order approximation to indigenous population dynamics of the Amazonian biome over the final 2,500 years of pre-Columbian history. Our approach offers a rigorous alternative to watershed- or floodplain-focused discussions of indigenous population history, and also side-steps the potentially problematic issue of only employing dates from cherry-picked cultural phases. By choosing to examine the aggregate patterns derived from our SPD-based time series against their geographical distribution, we are able to identify robust patterns that suggest a potential ceiling to population growth was reached at around AD ~1200 AD. Inasmuch as changing regional growth rates provide a reasonable proxy for productive capacity (i.e. centennial-scale variation in the answer to the question of 'how many mouths can we feed'), our spatial analyses also provide a sharper and more nuanced control of regional demographic fluctuations that are related to specific pre-Columbian livelihoods in the Amazonian biome. Indeed, despite overall adherence to logistic growth (***Figure 2*****a**), no single cluster of data points (***Figure 2b***) shows sustained population growth throughout the entire 2,500 years of our analysis, highlighting that specific food producing strategies may not have been resilient at the scale of multiple centuries [12]. Lastly, our time-series analysis offers significant spatial and temporal refinements to the demographic dimension of broad ceramic traditions and potential association with language communities [5]. Specifically, our analyses strongly scaffold suggestions that major events of diversification of three of the most significant language families of the Amazonian biome took place as recently as the first millennium AD. Evidently, the trends we identify are robust only against the present state of the aggregate radiocarbon dataset for our study region. Future research will undoubtedly expand this dataset and potentially challenge the general outlook we provide. More than offering answers, however, the results of our analysis posit questions that we hope will encourage future research.

Acknowledgments

Special thanks to archaeologists who publish or make available online radiocarbon dates, as well as to their collaborators and supporters who have made possible archaeological excavations from which dated samples have been collected. Without their research, analyses such as presented here could not be undertaken. At the Institute of Archaeology, UCL, José Oliver, Vinicius Honorato, and Lara González Carretero supported continued work updating the R_Amazon radiocarbon database. Our special thanks to Stephen Shennan, Kevan Edinborough, Enrico Crema, Andrew Bevan, and Dorian Fuller for substantive and methodological insights. We also appreciated the attention of our colleagues and friends at the Amazonia INQUA/Landuse 6k (Barcelona 2016, Vancouver and Trinidad, 2017), and CROSSDEM (Tarragona, 2018) workshops, where we initially shared many of the ideas presented herein.

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ELECTRONIC SUPPLEMENTARY MATERIAL

Did pre-Columbian populations of the Amazonian biome reach carrying capacity during the Late Holocene?

M. Arroyo-Kalin, Philip Riris

SM1 - Spatial permutation testing

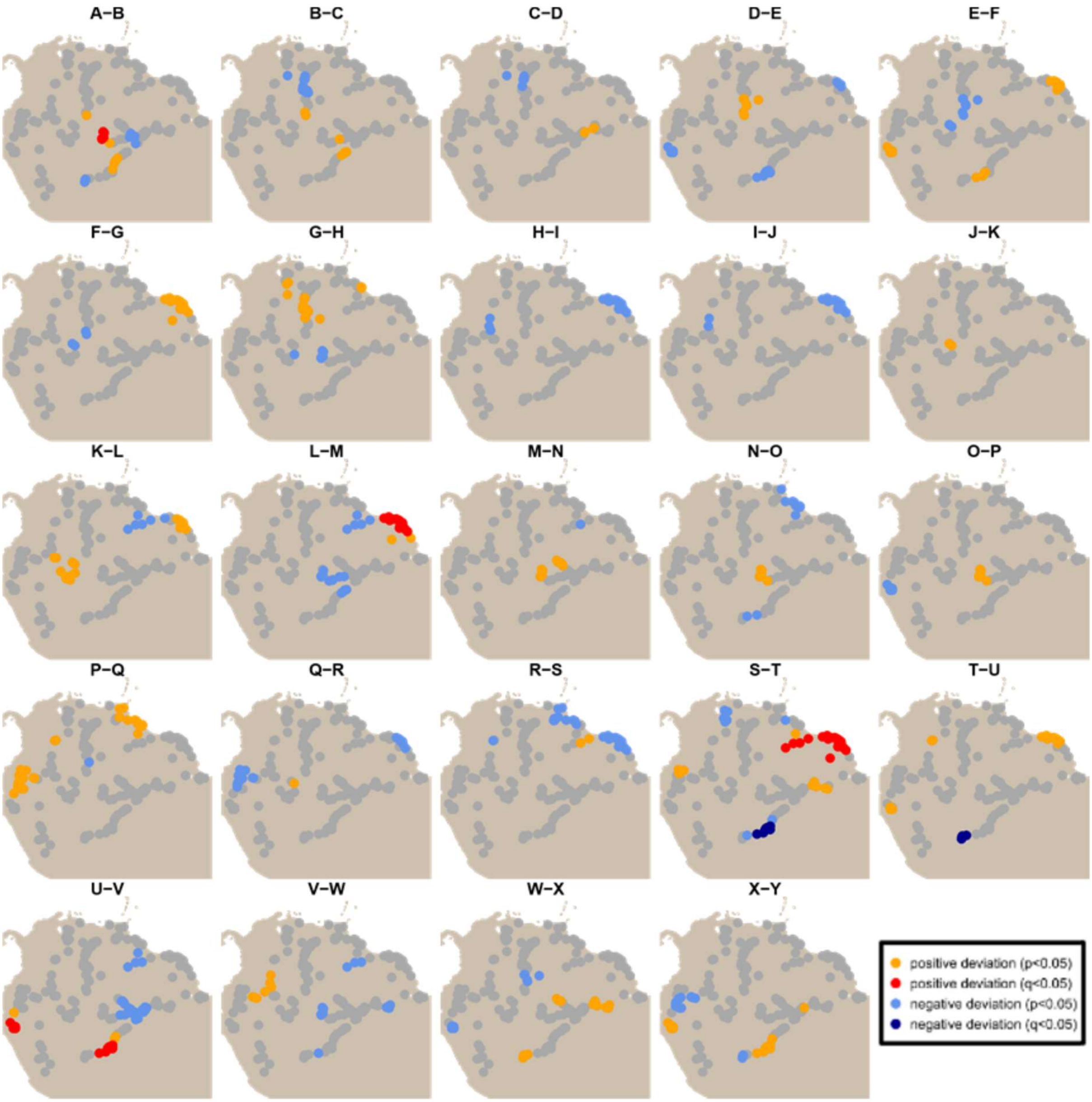

Figure SM1. All results of the SCPD-derived spatial permutation test with p- and q-values (colours) showing hot versus cold spots of population growth.

Figure SM1 reports q-values alongside p-values to showing hot versus cold spots of population growth while guarding against the increased likelihood of incorrectly rejecting or failing to reject a true null hypothesis in the context of multiple testing [1]. Hot spots are locations exhibiting an observed local growth rate significantly higher than the distribution of simulated local growth rates; cold spots are locations where the observed local growth rate is lower than the randomised set. Note distinction between phases that are significant to $p < .05$ and $q < .05$, which are rarer.

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SM2- R Code

```
### Did pre-Columbian populations of the Amazonian biome reach carrying capacity? ###
###                                                                 ###
###                          CODE LOG                                   ###
##############################################################################################
#####

# Manuel Arroyo-Kalin & Philip Riris

## Load packages

require(rcarbon)
require(sp)
require(dbscan)
require(dplyr)
require(ggplot2)
require(rgdal)
require(spatstat)
require(raster)
require(rworldmap)

## Setup

dataset <- read.csv("ramazon_north.csv", header=TRUE)
dataset$SiteCode <- paste("S",as.numeric(dataset$SiteID),sep="")

spdataset <- read.csv("spdataset2.csv", header=TRUE)# Sites with no coordinates
spdataset$SiteCode <- paste("S",as.numeric(spdataset$SiteID),sep="")

amazoncurve <- mixCurves(calCurve1 = "intcal13", calCurve2 = "shcal13", p = 0.5)
```

```
bins=binPrep(sites=dataset$SiteCode,ages=dataset$Age,h=200)
calDates=calibrate(dataset$Age,dataset$SD, normalised=FALSE, calCurves = amazoncurve, ncores=4)

## Density map

locations = unique(data.frame(SiteID = spdataset$SiteCode,
                    Longitude = spdataset$W,
                    Latitude = spdataset$N))

rownames(locations) = as.character(locations$SiteID)
locations= locations[,-1]
coordinates(locations) <-c("Longitude", "Latitude")
proj4string(locations) <- CRS("+proj=longlat +datum=WGS84")

# South America Albers equal area conic projection
AEACP <- c("+proj=aea +lat_1=-5 +lat_2=-42 +lat_0=-32 +lon_0=-60 +x_0=0 +y_0=0 +ellps=aust_SA +units=m
+no_defs")

locations2 <- spTransform(locations, AEACP)

world <- getMap(resolution="low")
sa <- subset(world, NAME %in% c(
  "Venezuela", "Brazil", "Bolivia", "Ecuador",
  "Colombia", "Guyana", "Suriname", "French Guiana",
  "Peru"))

sa <- crop(sa, extent(-85, -45, -15, 15))
sa <- spTransform(sa, AEACP)

# Convert to spatstat "ppp" object and use cropped area as window for kernel density
locations.p <- as(locations2, "ppp")
locations.p <- rescale(locations.p, 1000, unitname = "km")
win <- as(sa, "owin")
win <- rescale(win, 1000, unitname="km")
locations.p <- locations.p[win]

dens <- density.ppp(locations.p, dimyx = c(1024, 1024), kernel="epanechnikov", sigma=100)

## Exponential fit

aspd <- spd(x = calDates, timeRange = c(3000,500), bins = bins, datenormalised = FALSE,
        spdnormalised = TRUE, runm=50) # SPD is normalised for later modelfit

meds <- medCal(calDates)

# Must use only one calibration curve for modelTest()
calDates.int=calibrate(dataset$Age,dataset$SD, normalised=FALSE, calCurves = "intcal13", ncores=7)

modelfit <- modelTest(x = calDates.int, errors = dataset$SD, bins = bins, runm = 50, timeRange = c(3000,500),
            model = "exponential", method = "uncalsample", spdnormalised = FALSE, nsim=999, ncores=7)
## Composite kernel density estimate

asde <- sampleDates(x = calDates, bins = bins, nsim = 999, boot = TRUE)

ackde <- ckde(x = asde, timeRange = c(3000, 500), bw = 50, normalised = FALSE)

ama <- MCdensity(as.matrix(dataset[5:6])) # MCDensity & ggr functions from McLaughlin (2018) JAMT
```

```
## Exponential-Logistic fit

earlytime <- seq(3000, 2201, -1)

early_fit <- nls(y ~ exp(a + b * x), data = data.frame(x = earlytime,
                                           y = aspd$grid$PrDens[1:800]), start = list(a = 0, b = 0))
est_early <- predict(early_fit, list(x = earlytime))
predicted_early <- data.frame(calBP=earlytime, PrDens = est_early)

latetime <- seq(2200, 500, -1)

late_fit <- drm(y ~ x, data=data.frame(x=latetime,
                              y=aspd$grid$PrDens[801:2501]), fct=L.3())

est_late <- as.numeric(predict(late_fit,data.frame(x=latetime)))

predicted_late <- data.frame(calBP=latetime, PrDens = est_late)

combined_predgrid <- rbind(predicted_early, predicted_late)

modelfit.2200 <- modelTest(x = calDates.int, errors = dataset$SD, bins = bins, runm = 50, timeRange =
c(3000,500),
                     model = "custom", method = "uncalsample", spdnormalised = TRUE, normalised = FALSE,
                     nsim=999, ncores=7,
                     predgrid = combined_predgrid)

#Spatial

breaks = seq(3000,500,-100)
edge = 100
tr = c(3000,500)

sites = unique(data.frame(SiteID=spdataset$SiteCode,
                    Longitude=spdataset$W,
                    Latitude=spdataset$N))

locs = data.frame(Longitude=sites$Longitude,
              Latitude=sites$Latitude)

rownames(locs)=sites$SiteID

coordinates(locs) <- c("Longitude", "Latitude")

proj4string(locs) <- CRS("+proj=longlat +datum=WGS84")

spbins <- binPrep(sites = spdataset$SiteCode, ages = spdataset$Age, h = 200)
spcalDates <- calibrate(spdataset$Age,spdataset$SD, normalised=FALSE, calCurves = amazoncurve, ncores=7)

distSamples=spDists(locs,locs,longlat = TRUE)

spatialweights=spweights(distSamples,h=250)

res.locations=sptest(spcalDates,timeRange=tr,bins=spbins,locations=locs,
                spatialweights=spatialweights,breaks=breaks,ncores=7,nsim=10000,
                permute="locations",datenormalised=FALSE)
```

```
##Plotting

#Figure 1

par(mfrow=c(2,2))
par(mar=c(2,3,2,3))

plot(dens, box = FALSE, main="",
    ribside = "bottom", ribscale = 1000, ribsep = 0.05, ribwid = 0.05)
points(locations.p, pch=21, col="black", bg=rgb(1,1,1,0.4), lwd=1)

plot(modelfit, calendar="BCAD")
abline(v=seq(-1000, 1500, 250), lty=3, col="white", lwd=2)
barCodes(BPtoBCAD(meds),yrng=c(0,0.025), col = "#BA9BC9", width=2)
text(labels = "dates = 1393\nbins = 788\nsites = 375\np = 0.031", y=0.47, x=-1000, font = 3, adj=0)

plot(ackde, calendar="BCAD")
abline(v=seq(-1000, 1500, 250), lty=3, col="white", lwd=2)

plot(ggr(ama), xlim=c(-1000,1500), ylim=c(-1.3,1.3), xlab="Years BC/AD", col="grey", xaxt="n")
axis(side=1,at = c(-1000,-500,1,500,1000,1500), labels=c("1000", "500", "1", "500", "1000", "1500"))
abline(v=seq(-750, 1250, 250), lty=3, col="white", lwd=2)
abline(h=0, lty=2, col="black", lwd=2)
rect(-175,-2,-225,2, col=rgb(1, 0.6, 0, 0.3), border = NA)
rect(545,-2,650,2, col=rgb(1, 0.6, 0, 0.3), border = NA)
rect(840,-2,1005,2, col=rgb(1, 0.6, 0, 0.3), border = NA)
rect(1195,-2,1245,2, col=rgb(1, 0.6, 0, 0.3), border = NA)

#Figure 2a

plot(modelfit.2200, calendar="BCAD",
    drawaxes=FALSE, xlim=c(-1100,1500))
title(xlab="Years BC/AD", ylab="Summed Probability")
axis(side=1,at = c(-1000,-500,1,500,1000,1500), labels=c("1000", "500", "1", "500", "1000", "1500"))
axis(side=2,at = seq(0,0.001,0.0002), labels=seq(0,0.001,0.0002))
text(labels = "dates = 1393\nbins = 788\nsites = 375\np = 0.08", y=0.00079, x=-1000, font = 3, adj=0)
abline(v=BPtoBCAD(2200), lty=2, lwd=2)

ypos <- c(0.00008, 0.00006)

segments(x0 = BPtoBCAD(breaks[1]), y0 = ypos[1], x1 = BPtoBCAD(breaks[2]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[2]), y0 = ypos[2], x1 = BPtoBCAD(breaks[3]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[3]), y0 = ypos[1], x1 = BPtoBCAD(breaks[4]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[4]), y0 = ypos[2], x1 = BPtoBCAD(breaks[5]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[5]), y0 = ypos[1], x1 = BPtoBCAD(breaks[6]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[6]), y0 = ypos[2], x1 = BPtoBCAD(breaks[7]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[7]), y0 = ypos[1], x1 = BPtoBCAD(breaks[8]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[8]), y0 = ypos[2], x1 = BPtoBCAD(breaks[9]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[9]), y0 = ypos[1], x1 = BPtoBCAD(breaks[10]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[10]), y0 = ypos[2], x1 = BPtoBCAD(breaks[11]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[11]), y0 = ypos[1], x1 = BPtoBCAD(breaks[12]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[12]), y0 = ypos[2], x1 = BPtoBCAD(breaks[13]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[13]), y0 = ypos[1], x1 = BPtoBCAD(breaks[14]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[14]), y0 = ypos[2], x1 = BPtoBCAD(breaks[15]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[15]), y0 = ypos[1], x1 = BPtoBCAD(breaks[16]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[16]), y0 = ypos[2], x1 = BPtoBCAD(breaks[17]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[17]), y0 = ypos[1], x1 = BPtoBCAD(breaks[18]), lwd=5, col="grey40", lend=1)
```

```
segments(x0 = BPtoBCAD(breaks[18]), y0 = ypos[2], x1 = BPtoBCAD(breaks[19]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[19]), y0 = ypos[1], x1 = BPtoBCAD(breaks[20]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[20]), y0 = ypos[2], x1 = BPtoBCAD(breaks[21]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[21]), y0 = ypos[1], x1 = BPtoBCAD(breaks[22]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[22]), y0 = ypos[2], x1 = BPtoBCAD(breaks[23]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[23]), y0 = ypos[1], x1 = BPtoBCAD(breaks[24]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[24]), y0 = ypos[2], x1 = BPtoBCAD(breaks[25]), lwd=5, col="grey40", lend=1)
segments(x0 = BPtoBCAD(breaks[25]), y0 = ypos[1], x1 = BPtoBCAD(breaks[26]), lwd=5, col="grey40", lend=1)

alphalabs <- LETTERS[seq(from=1, to=25, 2)]
alphabreaks <- seq(3000,500, -200)
betalabs <- LETTERS[seq(from=2, to=24, 2)]
betabreaks <- seq(2900,700, -200)
text(BPtoBCAD(alphabreaks-50), 0.0001, alphalabs, font=2)
text(BPtoBCAD(betabreaks-50), 0.00004, betalabs, font=2)

#Figure2b

par(mfrow=c(5,5))

xrange=bbox(res.locations$locations)[1,]
yrange=bbox(res.locations$locations)[2,]
base=getMap(resolution="low")

for (i in 1:24) {
  par(mar=c(0.1,0.1,1,0.5))
  plot(base,col="antiquewhite3",border="antiquewhite3",xlim=xrange,ylim=yrange,
       main=paste(LETTERS[i], LETTERS[i+1], sep="-"))
  plot(res.locations,index=i,add=TRUE,legend=FALSE,option="test", baseSize=2, breakRange=c(-0.005, 0.005))
  #  dev.off()
}

dev.off()

par(mfrow=c(5,5))

for (i in 1:24) {
  par(mar=c(0.1,0.1,1,0.5))
  plot(base,col="antiquewhite3",border="antiquewhite3",xlim=xrange,ylim=yrange,
       main=paste(LETTERS[i], LETTERS[i+1], sep="-"))
  plot(res.locations,index=i,add=TRUE,legend=FALSE,option="raw", baseSize=2, breakRange=c(-0.005, 0.005))
  #  dev.off()
}
```

SM3. Ramazon North database

14C Laboratory Code	14C Age	SD	Lat	Lon	Refe-rence
ETH-41722	130	35	0	0	[6]
POZ-35845	130	30	0	0	[6]
ETH-41721	170	60	0	0	[6]
OBDY-523	170	170	0	0	[2]
KIA-33044	195	20	0	0	[6]
POZ-35841	195	30	0	0	[6]
POZ-42515	205	25	0	0	[16]
Lyon-7782	220	40	0	0	[6]
OBDY-728	240	50	0	0	[2]
OBDY-727	260	50	0	0	[2]
[unreported]	300	50	5.08	-72.13	[1]
OBDY-732	310	110	0	0	[2]
Beta-25390	320	50	2.69	-67.38	[4]
Beta-386837	320	30	-3.64	-64.96	[3]
UGAMS-4055	320	25	0	0	[5]
KIA-36134.2	325	25	0	0	[6]
Beta-361091	330	30	-0.66	-72.08	[7]
QC-312A	340	80	6.41	-67.19	[8]
Beta-143582	350	40	-3.28	-60.2	[11]
Beta-256014	350	40	-1.85	-56.53	[10]
Beta-420227	350	30	-3.12	-58.55	[9]
Beta-294097	360	30	-8.66	-63.93	[152]
KIA-31239	360	25	0	0	[6]
Lyon-7786	360	45	0	0	[6]
Beta-129410	370	40	-1.08	-49.58	[12]
Beta-260327	370	40	-8.68	-63.92	[152]
Beta-421498	370	30	-3.12	-58.55	[9]
[unreported]	380	50	0	-73.75	[13]
Beta-410640	380	30	-3.12	-58.55	[9]
OBDY-796	380	35	4.93	-52.57	[2]
GrN-14999	385	30	-0.66	-72.08	[14]
Beta-179720	390	30	-3.25	-78.69	[15]
KIA-31242	390	20	0	0	[6]
OxA-2487	390	70	7.87	-65.73	[8]
POZ-30850	395	30	0	0	[6]
POZ-42485	395	30	0	0	[16]
Beta-361094	400	30	-0.66	-72.08	[7]
SI-2752	405	60	-2.54	-60.78	[17]
GIF-6956	410	60	0	0	[2]
KIA-26022	410	20	5.17	-52.67	[18]
QC-310B	410	80	7.87	-65.73	[8]
QC-321	410	85	7.87	-65.73	[8]
WK-6838	413	56	-2.43	-54.71	[19]

Lyon-7757	415	45	0	0	[6]
[unreported]	416	59	-2.07	-54.17	[20]
[unreported]	418	60	-2.07	-54.17	[20]
[unreported]	418	56	-2.07	-54.17	[20]
WK-6842	418	59	-2.43	-54.71	[19]
Beta-129411	420	60	-1.08	-49.58	[12]
Beta-22751	420	50	-8.83	-63.37	[21]
Beta-420226	420	30	-3.12	-58.55	[9]
OxA-2499	420	65	7.87	-65.73	[8]
POZ-35840	420	30	0	0	[6]
KIA-31240	425	20	0	0	[6]
WK-6841	425	56	-2.43	-54.71	[19]
[unreported]	429	61	-2.07	-54.17	[20]
Beta-288152	430	40	-8.64	-63.63	[153]
Beta-48286	430	50	-2.4	-58.23	[21]
OBDY-1339	430	40	0	0	[22]
Beta-261405	440	60	-4.83	-79.26	[23]
Lyon-4949	440	30	0	0	[6]
OxA-34862	441	25	5.64	-67.63	[24]
SI-870	445	85	8.69	-62.2	[25]
Beta-420225	450	30	-3.12	-58.55	[9]
WK-6837	452	57	-2.43	-54.71	[19]
IVIC-8622	455	85	7.85	-65.79	[26]
WK-6845	455	63	-2.43	-54.71	[19]
QC-324A	460	80	7.87	-65.73	[8]
[unreported]	469	65	-2.07	-54.17	[20]
Beta-420255	470	30	-3.12	-58.55	[9]
Beta-51276	470	70	-8.83	-63.37	[21]
IVIC-8623	470	80	7.85	-65.79	[26]
OxA-2488	475	70	7.87	-65.73	[8]
[unreported]	480	30	-5.7	-78.78	[27]
Beta-260336	480	40	-8.6	-63.81	[152]
Gx-6265	485	120	7.59	-66.38	[28]
OxA-34858	487	25	5.64	-67.63	[24]
OxA-34860	488	25	5.64	-67.63	[24]
[unreported]	489	56	-2.07	-54.17	[20]
[unreported]	490	30	-2.83	-58.18	[29]
Beta-260339	490	50	-8.72	-63.97	[152]
Beta-386838	490	30	-3.64	-64.96	[3]
GX-1617	490	90	8.25	-62.77	[30]
OBDY-1414	490	50	0	0	[22]
SI-1370	490	45	7.85	-65.79	[26]
OxA-34865	496	25	5.64	-67.63	[24]
Beta-262404	500	60	-0.1	-77.44	[31]
Beta-294096	500	30	-8.66	-63.93	[152]
SI-5377	500	55	-5.62	-60.99	[155]

[unreported]	502	56	-2.07	-54.17	[20]
UGAMS-4567b	505	80	0	0	[16]
OxA-34866	509	24	5.64	-67.63	[24]
[unreported]	510	56	-2.07	-54.17	[20]
Beta-109183	510	70	-3.1	-60.37	[32]
GrN-14996	510	40	-0.66	-72.08	[7]
OBDY-1229	510	40	0	0	[22]
OBDY-794	510	40	5.17	-52.69	[2]
OxA-2533	510	80	7.85	-65.81	[8]
QC-0	510	70	7.87	-65.73	[8]
WK-6846	512	59	-2.43	-54.71	[19]
IVIC-9399*	515	75	6.44	-67.16	[26]
Beta-109181	520	80	-3.1	-60.37	[32]
Beta-332851	520	30	-0.66	-72.08	[7]
GrN-19809b	520	15	1.37	-72.96	[33]
GX-1616	520	95	8.31	-62.86	[34]
Beta-146214	530	100	-1.11	-49.61	[12]
Beta-330919	530	30	-1.77	-56.5	[35]
OxA-36196	530	26	5.79	-67.6	[24]
PA-413	530	60	0	0	[2]
OxA-34856	533	24	5.64	-67.63	[24]
Gx-8992	535	140	7.11	-66.74	[36]
WK-6840	537	58	-2.43	-54.71	[19]
Beta-280922	540	40	-8.49	-63.58	[153]
IVIC-9448	540	75	7.13	-66.93	[26]
OBDY-1328	540	40	0	0	[22]
UGAMS-4568	540	25	0	0	[16]
P-163	544	113	4.08	-67.83	[37]
SI-0	545	60	-6.99	-62.81	[81]
SI-1368	545	60	7.77	-65.81	[26]
SI-4284	545	60	-6.99	-62.83	[81]
Beta-129417	550	40	-1.08	-49.58	[12]
Beta-16649	550	100	8.5	-70.56	[41]
Beta-190284	550	40	-1.71	-56.41	[38]
Beta-64528	550	60	7.77	-65.81	[40]
IVIC-8624	550	80	7.85	-65.79	[8]
OxA-2489	550	70	7.87	-65.73	[8]
SI-2775	550	100	-1.96	-56.73	[39]
Beta-32900	560	30	-1.85	-56.53	[10]
GrN-8459	560	21	-1.34	-69.59	[42]
SI-6375	560	75	-1.34	-69.59	[42]
IVIC-8627	565	80	7.87	-65.85	[8]
Beta-143587	570	40	-3.28	-60.2	[11]
Beta-255792	570	40	3.52	-51.48	[44]
Beta-292839	570	40	-0.06	-77.49	[31]
Beta-322894	570	30	-1.85	-56.53	[10]

Beta-78437	570	80	0.58	-67.5	[43]
Gx-8986	570	155	6.25	-67.48	[36]
N-310	575	105	-8.85	-74.31	[45]
GrN-14988	580	30	-0.66	-72.08	[14]
KIA-32394	583	25	5.26	-54.25	[46]
WK-6833	583	57	-2.43	-54.71	[19]
GrN-14993	585	30	-0.66	-72.08	[14]
P-164	585	93	4.13	-67.87	[47]
POZ-42484	585	35	0	0	[16]
WK-6839	586	56	-2.43	-54.71	[19]
Beta-115897	590	40	-1.01	-77.4	[31]
Beta-280923	590	40	-8.49	-63.58	[153]
Beta-109178	600	80	-3.1	-60.37	[32]
Beta-255787	600	40	3.52	-51.48	[44]
GrN-19514	600	40	0.74	-72.74	[33]
ISGS-384	600	65	-2.53	-77.19	[48]
IVIC-418	600	80	8.37	-62.65	[49]
OBDY-1222	600	50	0	0	[22]
GX-1615	605	110	8.69	-62.2	[34]
OxA-29510	605	23	-9.94	-67.5	[156]
Beta-106436	610	50	-1.65	-61.55	[32]
Beta-190278	610	40	-1.42	-56.45	[38]
Beta-190279	610	40	-1.42	-56.45	[38]
OxA-2495	610	65	7.87	-65.73	[8]
OxA-2497	610	70	7.87	-65.73	[8]
P-162	619	103	4.08	-67.83	[37]
[unreported]	620	40	-2.82	-58.67	[50]
Beta-258150	620	40	-8.6	-63.53	[153]
Beta-280924	620	60	-8.49	-63.58	[153]
OBDY-1411	620	50	0	0	[22]
IVIC-8625	625	80	7.85	-65.79	[8]
OxA-15504	625	26	-3.19	-60.35	[52]
SI-4053	625	60	-1.9	-61.44	[51]
SI-4270	625	60	-7.39	-63.02	[81]
Beta-190280	630	100	-1.42	-56.45	[38]
Beta-22639	630	90	5.79	-67.6	[55]
Beta-258148	630	40	-3.28	-60.12	[54]
Y-1544	630	60	-8.86	-74.31	[53]
OxA-34863	633	24	5.64	-67.63	[24]
[unreported]	640	50	-2.17	-56.1	[56]
Beta-115900	640	40	-1.02	-77.43	[31]
Poz-44817	645	30	4.89	-52.31	[57]
Beta-128710	650	60	-0.89	-77.26	[31]
Beta-330937	650	30	-1.77	-56.5	[35]
GrN-19570	650	20	0.74	-72.74	[33]
IVIC-9449	650	75	7.71	-66.11	[26]

SI-868	650	70	8.44	-62.79	[25]
WK-6843	650	59	-2.43	-54.71	[19]
WK-6837	652	56	-2.43	-54.71	[19]
P-165	654	93	4.13	-67.87	[47]
Gx-8984	655	125	7.63	-66.42	[36]
Poz-44821	655	30	4.89	-52.31	[57]
Poz-44823	655	25	4.89	-52.31	[57]
OxA-34857	657	24	5.64	-67.63	[24]
Beta-280926	660	40	-8.34	-63.28	[153]
WK-6844	664	57	-2.43	-54.71	[19]
GX-2134	665	100	-12.54	-73.84	[58]
GX-6267	665	120	7.59	-66.38	[28]
IVIC-9398	665	80	7.18	-66.85	[26]
Beta-109184	670	60	-3.1	-60.37	[32]
Beta-188564	670	50	-3.04	-69.13	[60]
Beta-242444	670	40	-3.63	-62.11	[59]
Beta-242445	670	40	-3.63	-62.11	[59]
Beta-292840	670	40	-0.06	-77.49	[31]
GX-2133	670	90	-12.54	-73.84	[58]
IVIC-8626	670	80	7.85	-65.79	[8]
OBDY-1369	670	40	0	0	[22]
OxA-34861	673	25	5.64	-67.63	[24]
[unreported]	675	60	-2.07	-54.17	[20]
KIA-26021	675	25	5.17	-52.67	[18]
Poz-44828	675	30	4.89	-52.31	[57]
Poz-44835	675	30	4.89	-52.31	[57]
Gx-8983	680	155	7.63	-66.42	[36]
IVIC-5777	685	90	-2.78	-71.38	[61]
OxA-2498	685	65	7.87	-65.73	[8]
POZ-42486	685	30	0	0	[16]
Poz-44820	685	30	4.89	-52.31	[57]
OxA-34864	689	25	5.64	-67.63	[24]
ARC-2336	690	50	0	0	[6]
Beta-129412	690	60	-1.08	-49.58	[12]
Beta-18456	690	190	3.88	-67.44	[64]
Beta-221030	690	40	-2.18	-56.1	[63]
Beta-322895	690	30	-1.85	-56.53	[10]
Beta-322901	690	30	-1.85	-56.53	[10]
Beta-97530	690	40	-3.1	-60.37	[32]
SI-589	690	80	-0.42	-77.84	[62]
GrA-828	695	35	0.74	-72.74	[33]
GrN-14989	695	30	-0.66	-72.08	[14]
OxA-2491	695	70	7.87	-65.73	[8]
Beta-1506	705	60	-0.62	-72.39	[65]
OxA-29466	708	25	-9.94	-67.5	[156]

Beta-109180	710	80	-3.1	-60.37	[32]
Beta-109205	710	50	-1.01	-77.42	[31]
IVIC-9667	715	150	7.59	-66.38	[26]
QC-319	715	75	7.87	-65.73	[8]
OxA-35728	716	25	5.64	-67.63	[24]
[unreported]	720	30	2.27	-53.95	[66]
Beta-22642	720	90	5.79	-67.6	[55]
IVIC-9520	725	150	7.84	-65.75	[67]
Beta-110338	730	60	-1.01	-77.4	[31]
Beta-146221	730	80	-1.03	-49.7	[12]
GX-2137	730	105	-12.54	-73.84	[58]
OBDY-1350	730	60	0	0	[22]
POZ-36925	730	30	0	0	[6]
SI-4054	730	65	-1.45	-61.73	[51]
OxA-36134	731	26	5.79	-67.6	[24]
GrN-14990	735	30	-0.66	-72.08	[14]
Beta-338695	740	30	-4.33	-59.68	[81]
GrN-14998	740	35	-0.62	-72.39	[68]
Lyon-7783	740	40	0	0	[6]
KIA-32396	747	25	5.26	-54.25	[46]
Beta-254054	750	40	5.17	-52.69	[69]
Beta-383581	750	30	-2.5	-64.74	[70]
Beta-61570	750	80	-3.25	-78.69	[15]
Hela-616	750	35	-9.87	-67.53	[154]
IVIC-8543	750	80	7.85	-65.79	[26]
OBDY-1248	750	40	0	0	[22]
OBDY-1399	750	50	0	0	[22]
[unreported]	755	110	-0.88	-48.96	[20]
ARC-2272	755	45	0	0	[6]
GrN-14991	755	30	-0.66	-72.08	[7]
GX-16066	755	110	-0.63	-49.54	[71]
SI-4273	755	60	-6.59	-62.49	[81]
Beta-260321	760	40	-8.81	-63.95	[152]
IVIC-5774	760	90	-3.64	-70.59	[42]
QC-0	760	100	6.41	-67.19	[8]
IVIC-9397	765	80	7.05	-66.62	[26]
IAN-47	767	85	6.3	-70.2	[72]
OxA-34890	769	25	5.64	-67.63	[24]
P-269	769	51	-0.88	-75.46	[73]
Beta-100539	770	60	-2.21	-78.06	[74]
Poz-44822	770	40	4.89	-52.31	[57]
P-347	771	53	-0.88	-75.46	[73]
GrN-16968	775	25	-0.59	-72.4	[68]
[unreported]	780	30	5.37	-53.03	[66]
GIF--7551	780	60	0	0	[2]
Gx-8993	780	125	7.59	-66.38	[36]

POZ-35842	780	30	0	0	[6]
Beta-97529	790	40	-3.1	-60.37	[32]
OBDY-1412	790	40	0	0	[22]
KIA-36136	795	25	0	0	[6]
Beta-262409	800	60	-0.05	-77.44	[31]
GrN-19519	800	60	1.37	-72.96	[33]
OBDY-1324	800	40	0	0	[22]
P-373	800	47	-4.09	-63.12	[37]
ETH-40724	805	30	0	0	[6]
GrN-19718	805	30	0.74	-72.74	[33]
[unreported]	810	50	0.36	-76.78	[75]
POZ-32479	810	25	0	0	[6]
SI-4272	815	60	-6.59	-62.49	[81]
I-9157	819	90	-2.53	-77.19	[48]
Beta-262407	820	40	-0.1	-77.44	[31]
OxA-2496	820	70	7.87	-65.73	[8]
QC-322	820	85	7.87	-65.73	[8]
[unreported]	825	165	-0.88	-48.96	[20]
Lyon-4961	825	30	5.49	-53.22	[69]
POZ-35847	825	30	0	0	[6]
[unreported]	830	70	0.36	-76.78	[75]
Beta-268447	830	40	-1.06	-77.58	[31]
Beta-268450	830	40	-1.06	-77.58	[31]
GX-2615	830	100	-10.2	-73.99	[58]
GX-5178	830	125	7.59	-66.38	[28]
POZ-30854/5	830	30	0	0	[16]
QC-325	830	85	7.87	-65.73	[8]
IVIC-9400	835	80	7.06	-66.73	[26]
KIA-36137	835	35	0	0	[6]
POZ-35846	835	30	0	0	[6]
Beta-21891	840	60	-0.66	-72.08	[14]
Beta-22911	840	40	5.65	-67.63	[76]
Beta-22912	840	40	5.65	-67.63	[76]
Beta-255786	840	40	3.52	-51.48	[44]
GX-6266	840	120	7.59	-66.38	[28]
OBDY-1326	840	40	0	0	[22]
P-166	843	96	4	-67.82	[47]
SI-4271	845	45	-7.35	-63	[81]
SI-873	845	70	8.36	-62.82	[25]
OxA-15503	846	27	-3.19	-60.35	[52]
[unreported]	850	40	-2.82	-58.67	[50]
Beta-106087	850	60	-2.21	-78.06	[74]
Beta-190277	850	80	-1.42	-56.45	[38]
Beta-93361	850	60	0.58	-67.5	[43]
OBDY-1227	850	40	0	0	[22]
OBDY-1280	850	40	0	0	[22]

P-169	850	95	3.88	-67.44	[47]
SI-1369	850	130	7.85	-65.79	[26]
SI-1369	850	130	7.77	-65.81	[26]
[unreported]	860	110	-0.88	-48.96	[20]
Beta-18451	860	90	7.18	-66.85	[64]
Beta-262406	860	40	-0.1	-77.44	[31]
Beta-280927	860	40	-8.34	-63.28	[153]
Beta-292838	860	40	-0.12	-77.51	[31]
POZ-33046	860	30	0	0	[6]
QC-309	860	70	7.87	-65.73	[8]
SI-590	860	100	-0.46	-77.89	[62]
OxA-2500	865	70	7.87	-65.73	[8]
PA-1945	865	40	0	0	[6]
OxA-34859	874	26	5.64	-67.63	[24]
GrN-19717	875	20	0.74	-72.74	[33]
Beta-115896	880	40	-1.01	-77.4	[31]
Beta-178915b	880	40	-3.28	-60.2	[77]
GrN-19703	880	50	0.74	-72.74	[33]
Lyon-4960a	880	30	5.49	-53.22	[69]
OBDY-1262	880	40	0	0	[22]
OBDY-1335	880	50	0	0	[22]
ARC-597	885	50	0	0	[22]
ETH-41721b	885	40	0	0	[6]
IVIC-10006	885	110	7.59	-66.38	[78]
POZ-30945	885	30	0	0	[6]
SI-4279	885	90	-6.99	-62.83	[81]
SI-5376	885	90	-5.77	-61.28	[81]
Beta-143594	890	120	-3.28	-60.2	[11]
Beta-146216	890	100	-1.12	-49.63	[12]
Beta-260322	890	40	-8.81	-63.95	[152]
Beta-297128	890	30	-4.33	-59.68	[81]
SI-2753	890	190	-2.81	-58.24	[17]
Lyon-6612	895	30	0	0	[6]
Poz-44830	895	30	4.89	-52.31	[57]
Poz-44832	895	35	4.89	-52.31	[57]
Poz-44834	895	30	4.89	-52.31	[57]
OxA-36135	899	30	5.79	-67.6	[24]
Beta-268449	900	40	-1.06	-77.58	[31]
Gx-8982	900	155	7.63	-66.42	[36]
Lyon-4959	900	30	5.49	-53.22	[69]
OBDY-1311	900	50	0	0	[22]
QC-0	900	90	6.41	-67.19	[8]
KIA-32395	905	26	5.26	-54.25	[46]
POZ-33044	905	30	0	0	[6]
POZ-35844	905	30	0	0	[6]
POZ-36004	905	30	0	0	[6]

Beta-128709	910	40	-0.89	-77.26	[31]
Beta-143592	910	40	-3.23	-60.27	[11]
Beta-178915	910	40	-3.28	-60.2	[77]
Beta-178919b	910	60	-3.23	-60.27	[79]
Beta-178921b	910	40	-3.23	-60.27	[79]
Beta-25393	910	70	1.85	-67.03	[4]
Beta-255789	910	40	2.5	-50.95	[44]
IVIC-575	910	70	2.51	-65.14	[80]
IVIC-5775	910	30	-2.78	-71.38	[42]
POZ-42487	910	30	0	0	[16]
OxA-2492	915	70	7.87	-65.73	[8]
SI-4278	915	70	-4.18	-59.31	[81]
Beta-262408	920	40	-0.1	-77.44	[31]
Beta-268448	920	40	-1.06	-77.58	[31]
Beta-294091	920	30	-8.84	-64.02	[152]
IVIC-5776	920	90	-2.78	-71.38	[61]
Lyon-4960b	920	30	5.49	-53.22	[69]
[unreported]	925	75	-0.88	-48.96	[20]
Lyon-4958	925	30	5.49	-53.22	[69]
[unreported]	930	190	-0.88	-48.96	[20]
[unreported]	930	50	0.36	-76.78	[20]
ARC-724	930	65	0	0	[22]
Beta-110339	930	100	-1.01	-77.4	[31]
Beta-262410	930	70	-0.05	-77.44	[31]
Beta-297120	930	30	-3.19	-60.35	[81]
GX-2132	930	130	-12.54	-73.84	[58]
OBDY-1264	930	40	0	0	[22]
OBDY-1354	930	50	0	0	[22]
IVIC-8937	935	80	7.84	-65.75	[67]
POZ-33045	935	30	0	0	[6]
UBA-20796	938	28	-1.85	-78.06	[82]
ARC-596	940	110	0	0	[22]
Beta-100308	940	60	-2.21	-78.06	[74]
Beta-115904	940	40	-1.01	-77.4	[31]
Beta-178918b	940	40	-3.28	-60.2	[77]
Beta-22913	940	40	5.65	-67.63	[76]
Beta-25387	940	60	4.02	-67.43	[64]
Beta-258151	940	40	-8.6	-63.53	[153]
Beta-294083	940	30	-8.81	-63.95	[152]
Beta-61568	940	60	-3.25	-78.69	[15]
OBDY-1257	940	40	0	0	[22]
OxA-35975	945	26	5.64	-67.63	[24]
SI-871	945	70	8.44	-62.79	[25]
ETH--49959	948	26	0	0	[6]
[unreported]	950	30	-5.72	-78.45	[27]
Beta-143601	950	40	-3.23	-60.27	[11]

Beta-143602	950	30	-3.23	-60.27	[11]
Beta-178919	950	60	-3.23	-60.27	[79]
Beta-260330	950	70	-8.81	-63.94	[152]
Beta-9909	950	120	8.48	-70.55	[41]
Lyon-7785	950	45	0	0	[6]
OxA-34373	951	28	5.6	-67.61	[24]
UBA-20799	953	28	-1.85	-78.06	[82]
[unreported]	955	195	-0.88	-48.96	[20]
IVIC-9231	955	80	7.87	-65.73	[8]
Lyon-4956	955	30	5.49	-53.22	[69]
Beta-143586	960	30	-3.28	-60.2	[11]
Beta-143595	960	40	-3.28	-60.2	[11]
Beta-143607	960	30	-3.23	-60.27	[11]
Beta-178921	960	40	-3.23	-60.27	[79]
Beta-202681	960	60	-3.28	-60.2	[79]
Beta-271185	960	40	-1.06	-77.58	[31]
Beta-322202	960	30	-2.43	-54.71	[83]
ARC-969	965	60	0	0	[22]
Poz-44831	965	30	4.89	-52.31	[57]
[unreported]	970	25	3.86	-51.83	[66]
Beta-178914	970	40	-3.28	-60.2	[77]
Beta-178918	970	40	-3.28	-60.2	[77]
Beta-255788	970	40	2.5	-50.95	[44]
Beta-386835	970	30	-3.36	-64.67	[3]
OBDY-1313	970	40	0	0	[22]
POZ-32476	970	30	0	0	[6]
UBA-20795	972	26	-1.85	-78.06	[82]
GrN-7936	975	50	5.8	-54.4	[84]
UBA-20798	978	28	-1.85	-78.06	[82]
Beta-143585	980	40	-3.28	-60.2	[11]
Beta-185963	980	60	-3.46	-69.88	[60]
Beta-258149	980	40	-8.6	-63.53	[153]
Beta-280925	980	40	-8.34	-63.28	[153]
Beta-383582	980	30	-2.5	-64.74	[70]
Beta-90009	980	60	-3.1	-60.37	[32]
GX-2139	980	240	-12.54	-73.84	[58]
UGAMS-4567a	980	25	0	0	[16]
[unreported]	984	21	4.89	-52.26	[66]
ETH--49958	985	27	0	0	[6]
KIA-25851	985	20	0	0	[6]
Poz-25851	985	20	4.89	-52.31	[57]
Beta-260332	990	40	-8.81	-63.95	[152]
Beta-271182	990	40	-1.06	-77.58	[31]
Beta-294086	990	30	-8.6	-63.81	[152]
Beta-330920	990	30	-1.77	-56.5	[35]
Beta-386836	990	30	-2.64	-64.6	[70]

KIA-36189	990	30	0	0	[6]
Lyon-4957	990	30	5.49	-53.22	[69]
[unreported]	995	220	-0.88	-48.96	[20]
GX-2136	995	110	-12.54	-73.84	[58]
Gx-8980	995	160	7.21	-66.78	[36]
IVIC-10007	995	115	7.59	-66.38	[78]
N-2355	995	80	-2.81	-58.24	[17]
SI-2355	995	80	-2.81	-58.24	[17]
[unreported]	1000	90	-0.88	-48.96	[20]
Beta-143588	1000	40	-3.28	-60.2	[11]
Beta-143589	1000	40	-3.28	-60.2	[11]
Beta-178925	1000	40	-3.23	-60.27	[85]
Beta-178971	1000	40	-3.28	-60.2	[77]
Beta-185962	1000	70	-3.46	-69.88	[60]
KIA-33862	1000	35	0	0	[6]
Lyon-6614	1000	30	0	0	[6]
GrN-19714	1005	20	0.74	-72.74	[33]
Gx-8988	1005	140	7.18	-66.85	[36]
SI-860	1005	95	8.5	-62.63	[25]
Beta-143583	1010	80	-3.28	-60.2	[11]
Beta-254058	1010	40	5.17	-52.69	[69]
Beta-255790	1010	40	2.5	-50.95	[44]
GX-15749	1010	110	-0.59	-72.4	[68]
IVIC-573	1010	70	2.51	-65.14	[80]
Lyon-6613	1010	30	0	0	[6]
N-2356	1010	85	-2.81	-58.24	[17]
SI-2356	1010	85	-2.81	-58.24	[17]
POZ-36002	1015	30	0	0	[6]
Beta-111424	1020	40	5.02	-72.33	[86]
Beta-21890	1020	70	-0.66	-72.08	[7]
OxA-2490	1020	70	7.87	-65.73	[8]
POZ-30957	1020	30	0	0	[6]
IVIC-5778	1025	90	-3.64	-70.59	[42]
[unreported]	1030	75	-0.88	-48.96	[20]
Beta-258147	1030	40	-3.28	-60.12	[54]
Beta-338693	1030	30	-4.33	-59.68	[81]
Beta-97257	1030	100	-3.1	-60.37	[32]
SI-5089	1030	75	-2.48	-58.27	[87]
P-262	1032	54	4.64	-67.78	[37]
Poz-44819	1035	35	4.89	-52.31	[57]
Beta-260323	1040	40	-8.81	-63.95	[152]
Beta-260325	1040	60	-8.81	-63.95	[152]
OBDY-1321	1040	40	0	0	[22]
OxA-5202	1040	70	7.87	-65.73	[8]
POZ-36001	1040	30	0	0	[6]

GX-2140	1045	105	-12.54	-73.84	[58]
KIA-33555	1045	20	5.26	-54.25	[46]
[unreported]	1050	40	-2.83	-58.18	[29]
Beta-143600	1050	40	-3.23	-60.27	[11]
Beta-178922	1050	40	-3.23	-60.27	[85]
Beta-185964	1050	60	-3.46	-69.88	[60]
Beta-406676	1050	30	-3.36	-64.67	[3]
POZ-36929	1050	30	0	0	[6]
SI-4057	1050	90	-1.05	-62.42	[51]
[unreported]	1060	50	-0.88	-48.96	[20]
Beta-178917	1060	40	-3.28	-60.2	[77]
Beta-188991	1060	40	-0.85	-49.88	[12]
Beta-258145	1060	40	-3.28	-60.12	[54]
Beta-48280	1060	50	-2.4	-58.23	[21]
GX-16063	1060	50	-0.63	-49.54	[71]
OBDY-1368	1060	50	0	0	[22]
GrN-19716	1065	50	0.74	-72.74	[33]
SI-5376	1065	90	-5.68	-61.26	[17]
[unreported]	1070	50	3.88	-60.9	[89]
Beta-100538	1070	70	-2.21	-78.06	[74]
Beta-109204	1070	40	-1.01	-77.4	[31]
Beta-143593	1070	50	-3.28	-60.2	[11]
Beta-178927	1070	40	-3.23	-60.27	[85]
Beta-90305	1070	90	-2.21	-78.06	[74]
GrN-4330	1070	70	-3.13	-59.94	[88]
OBDY-1337	1070	50	0	0	[22]
SI-4055	1070	70	-1.43	-61.88	[51]
[unreported]	1080	50	-0.88	-48.96	[20]
Beta-143598	1080	40	-3.28	-60.2	[11]
Beta-321196	1080	30	-2.46	-64.77	[90]
Beta-41949	1080	60	5.31	-57.35	[84]
GrN-4329	1080	70	-3.13	-59.94	[88]
Obdy-1062	1080	50	4.07	-52.73	[91]
Beta-25388	1090	50	4.02	-67.43	[64]
Beta-297127	1090	30	-4.33	-59.68	[81]
Beta-64529	1090	60	7.77	-65.81	[40]
KIA-33482	1090	35	0	0	[6]
Beta-109182	1100	60	-3.1	-60.37	[32]
Beta-143605	1100	30	-3.23	-60.27	[11]
Beta-143626	1100	40	-3.19	-60.34	[79]
Beta-21893	1100	90	-0.66	-72.08	[7]
Beta-324361	1100	30	-1.85	-78.06	[82]
WK-16223	1105	37	-3.28	-60.2	[52]
[unreported]	1110	60	-2.07	-54.17	[20]
Beta-202676	1110	70	-3.1	-60.37	[79]
Beta-292841	1110	30	-0.06	-77.49	[31]

Beta-361819	1110	30	-3.08	-58.57	[9]
SI-5378	1110	60	-5.62	-60.99	[155]
SI-6374	1110	40	-1.34	-69.59	[42]
[unreported]	1120	40	4.55	-52.64	[66]
[unreported]	1120	60	-0.88	-48.96	[66]
ACR-1954	1120	40	4.56	-52.21	[92]
ARC-585	1120	50	0	0	[22]
Beta-1508	1120	65	-0.62	-72.39	[65]
Beta-260326	1120	40	-8.81	-63.95	[152]
Beta-268446	1120	40	-1.06	-77.58	[31]
Beta-330934	1120	30	-1.77	-56.5	[35]
Beta-338692	1120	30	-4.33	-59.68	[81]
ETH-27818	1120	45	0	0	[6]
SI-2751	1125	90	-2.54	-60.78	[17]
Beta-143604	1130	40	-3.23	-60.27	[11]
Beta-145486	1130	40	-3.28	-60.2	[79]
ETH-27817	1130	50	0	0	[6]
OBDY-1330	1130	50	0	0	[22]
SI-5087	1135	75	-2.59	-58.05	[87]
Beta-134537	1140	40	-0.85	-49.88	[12]
Beta-160717	1140	60	-0.85	-49.88	[12]
Beta-178924b	1140	40	-3.23	-60.27	[79]
Beta-242454	1140	40	-4.25	-63.73	[95]
Beta-271184	1140	40	-1.06	-77.58	[31]
Beta-323285	1140	30	-1.36	-62.12	[94]
Obdy-1432	1140	40	4.07	-52.73	[91]
Y-1545	1140	80	-8.86	-74.31	[93]
Beta-1507	1145	80	-0.62	-72.39	[65]
Beta-143603	1150	40	-3.23	-60.27	[11]
Beta-178916b	1150	40	-3.28	-60.2	[77]
Beta-178923b	1150	40	-3.23	-60.27	[79]
GrN-4412	1150	75	-3.2	-59.83	[88]
N-311	1150	110	-3.91	-70.53	[61]
OxA-34371	1158	26	5.6	-67.61	[24]
P-161	1159	122	4.64	-67.78	[96]
Beta-18459	1160	200	4.01	-67.16	[64]
Beta-260324	1160	40	-8.81	-63.95	[152]
Beta-6950	1160	50	-0.62	-72.39	[97]
POZ-30853	1160	30	0	0	[6]
[unreported]	1170	40	-3.13	-58.8	[98]
Beta-178924	1170	40	-3.23	-60.27	[79]
Beta-25389	1170	70	4.02	-67.43	[64]
Beta-361818	1170	30	-3.08	-58.57	[9]
OBDY-1408	1170	50	0	0	[22]
QC-0	1170	90	6.41	-67.19	[8]
QC-0	1170	95	7.77	-65.81	[8]

SI-33	1170	65	-4.09	-63.12	[88]
IVIC-9666	1175	85	7.59	-66.38	[26]
Beta-178916	1180	40	-3.28	-60.2	[77]
Beta-178923	1180	40	-3.23	-60.27	[79]
Beta-33460	1180	70	5.8	-67.5	[76]
GrN-19713	1180	20	0.74	-72.74	[33]
N-312	1180	105	-2.75	-60.43	[53]
P-370	1187	48	-4.09	-63.12	[37]
P-160	1189	93	4.64	-67.78	[99]
Beta-185013	1190	40	-0.85	-49.88	[12]
GrN-19704	1190	20	0.74	-72.74	[33]
WK-16224	1191	38	-3.28	-60.2	[52]
Ua-37257	1195	30	-9.94	-67.5	[154]
Beta-180942	1200	60	-0.85	-49.88	[12]
Beta-25391	1200	80	3.67	-67.27	[4]
QC-326	1200	85	7.87	-65.73	[8]
Ua-37258	1205	30	-9.94	-67.5	[154]
[unreported]	1210	50	-0.88	-48.96	[20]
Beta-100537	1210	80	-2.21	-78.06	[74]
Beta-271186	1210	40	-1.06	-77.58	[31]
DIC-798	1210	65	-2.55	-77.41	[48]
SI-6579	1210	60	-6	-61.6	[81]
OxA-15505	1216	27	-3.19	-60.35	[52]
Beta-22637	1220	70	5.6	-67.61	[40]
Beta-321195	1220	30	-2.46	-64.77	[90]
GrN-4332	1220	60	-4.15	-63.19	[88]
IVIC-8547	1220	80	7.77	-65.81	[40]
POZ-32475	1225	30	0	0	[6]
[unreported]	1230	40	-3.13	-58.8	[98]
Beta-106437	1230	70	-3.1	-60.37	[32]
Beta-228148	1230	40	-4.13	-69.92	[100]
Beta-52135	1230	80	5.8	-67.5	[101]
IVIC-10747	1230	130	7.84	-65.75	[67]
OBDY-1334	1230	50	0	0	[22]
QC-0	1230	130	7.84	-65.75	[8]
GX-5179	1235	135	7.59	-66.38	[78]
Beta-178928b	1240	40	-3.23	-60.27	[79]
Beta-294099	1240	30	-8.86	-64.03	[152]
Beta-383585	1240	30	-2.64	-64.6	[70]
IVIC-8542	1240	105	7.77	-65.81	[40]
P-996	1249	51	-10.3	-74.3	[102]
Beta-143584	1250	70	-3.28	-60.2	[11]
Beta-143591	1250	80	-3.28	-60.2	[11]
Beta-179075	1250	60	-0.85	-49.88	[12]
Beta-179075b	1250	60	-0.85	-49.88	[12]
Beta-323281	1250	30	-8.86	-64.06	[153]

IVIC-6083	1250	130	-3.64	-70.59	[42]
OxA-2494b	1250	70	7.87	-65.73	[8]
SI-861	1250	110	8.5	-62.63	[25]
[unreported]	1255	165	-0.88	-48.96	[20]
GX-16075	1255	165	-0.63	-49.54	[71]
Beta-117266	1260	50	8.37	-70.45	[104]
Beta-143606	1260	40	-3.23	-60.27	[11]
Beta-143623	1260	30	-3.19	-60.34	[79]
Beta-255793	1260	40	-0.42	-51.9	[44]
OBDY-1224	1260	40	0	0	[22]
POZ-32477	1260	30	0	0	[6]
SI-199	1260	200	-0.63	-49.54	[103]
P-261	1263	54	4.08	-67.83	[37]
Beta-178928	1270	40	-3.23	-60.27	[79]
Beta-268451	1270	40	-1.06	-77.58	[31]
Beta-294196	1270	30	-2.5	-64.74	[70]
Beta-386834	1270	30	-2.5	-64.74	[70]
Beta-90723	1270	60	-3.1	-60.37	[32]
OBDY-1316	1270	40	0	0	[22]
Ua-37255	1275	30	-9.87	-67.53	[154]
Beta-146217	1280	50	-1.12	-49.63	[12]
Beta-271187	1280	40	-1.06	-77.58	[31]
Beta-294087	1280	30	-8.6	-63.81	[152]
ARC-934	1290	50	0	0	[22]
Beta-117265	1290	50	8.37	-70.45	[104]
Beta-134538	1290	60	-0.85	-49.88	[12]
Beta-143609	1290	30	-3.19	-60.34	[11]
Beta-143613	1290	40	-3.19	-60.34	[11]
SI-4267	1290	60	-9.59	-65.37	[157]
QC-327	1295	90	7.77	-65.81	[8]
Beta-143599	1300	40	-3.28	-60.2	[11]
Beta-160716	1300	40	-0.85	-49.88	[12]
Beta-18453	1300	90	3.65	-66.95	[64]
Beta-202923	1300	70	-5.2	-74.74	[105]
Beta-25396	1300	70	2.67	-67.48	[4]
Beta-27258	1300	100	8.37	-70.51	[41]
IVIC-179	1300	70	9.73	-70.44	[106]
Beta-143620	1310	40	-3.19	-60.34	[11]
Beta-338694	1310	30	-4.33	-59.68	[81]
GrN-4331	1310	60	-4.15	-63.19	[88]
OBDY-797	1310	35	0	0	[2]
P-588	1318	59	-1.66	-69.18	[107]
Beta-143619	1320	60	-3.19	-60.34	[11]
GrN-16969	1320	30	-0.59	-72.4	[68]
OxA-2494	1320	80	7.87	-65.73	[8]
Beta-143612	1330	40	-3.19	-60.34	[11]

Beta-297125	1330	50	-4.33	-59.68	[81]
GrN-16971	1330	30	-0.59	-72.4	[68]
Gx-1618	1330	95	8.69	-62.2	[34]
GX-16061	1335	185	-0.63	-49.54	[71]
IVIC-6072	1335	125	-3.64	-70.59	[42]
Beta-143617	1340	40	-3.19	-60.34	[11]
Ua-37236	1340	35	-9.87	-67.53	[154]
UGAMS-4054	1340	25	0	0	[5]
[unreported]	1345	55	-2.84	-58.21	[98]
P-995	1346	110	-10.49	-74.82	[73]
Beta-143618	1350	40	-3.19	-60.34	[11]
Beta-143627	1350	40	-3.19	-60.34	[79]
Beta-188565	1350	40	-3.04	-69.13	[60]
Beta-202925	1350	60	-5.2	-74.74	[105]
Lyon-8180	1355	45	4.07	-52.73	[91]
POZ-32480	1355	30	0	0	[6]
Beta-143614	1360	50	-3.19	-60.34	[11]
Beta-271188	1360	40	-1.06	-77.58	[31]
Beta-330940	1360	30	-1.77	-56.5	[35]
Lyon-7756	1360	50	0	0	[6]
QC-0	1360	140	7.77	-65.81	[8]
SI-869	1360	75	8.39	-62.69	[25]
GrN-14992	1365	30	-0.66	-72.08	[14]
Beta-143610	1370	40	-3.19	-60.34	[11]
OxA-2527	1370	80	7.87	-65.73	[8]
SI-387	1370	200	-0.63	-49.54	[103]
Y-0	1370	80	8.66	-62.24	[108]
GrN-19706	1375	40	0.74	-72.74	[33]
OxA-2529	1380	80	7.87	-65.73	[8]
Beta-145484	1390	40	-3.28	-60.2	[79]
Beta-294082	1390	40	-8.81	-63.95	[152]
Beta-21892	1400	80	-0.66	-72.08	[14]
Beta-258146	1400	40	-3.28	-60.12	[54]
OBDY-795	1400	60	0	0	[2]
GX-15750	1415	75	-0.59	-72.4	[68]
Beta-1505	1420	70	-0.62	-72.39	[65]
Beta-330939	1420	30	-1.77	-56.5	[35]
OBDY-1361	1420	40	0	0	[22]
Y-0	1420	80	8.66	-62.24	[108]
P-997	1426	100	-10.3	-74.3	[102]
Beta-111425	1430	40	5.02	-72.33	[86]
OBDY-1317	1430	40	0	0	[22]
OBDY-799	1430	30	0	0	[2]
GrN-19719	1435	55	0.74	-72.74	[33]
Beta-143615	1440	70	-3.19	-60.34	[11]
SI-330	1440	70	-0.79	-75.66	[73]

Beta-22640	1450	90	5.6	-67.61	[55]
Beta-281106	1450	60	-1.77	-56.5	[35]
OxA-2528	1450	80	7.87	-65.73	[8]
QC-0	1450	75	7.77	-65.81	[8]
SI-872	1450	70	8.36	-62.82	[25]
Gx-8981	1455	140	7.21	-66.78	[36]
SI-684	1455	70	-0.46	-77.89	[62]
[unreported]	1465	25	3.87	-51.82	[66]
KIA-30207	1465	25	0	0	[6]
Beta-322896	1470	30	-1.85	-56.53	[10]
OBDY-798	1470	40	0	0	[2]
SI-386	1470	200	-0.63	-49.54	[103]
SI-864	1470	70	8.69	-62.2	[109]
ARC-709	1480	50	0	0	[22]
Beta-1509	1480	95	-0.62	-72.39	[65]
Ua-37259	1485	35	-9.94	-67.5	[154]
OxA-34374	1488	30	5.6	-67.61	[24]
[unreported]	1490	40	-2.82	-58.67	[50]
Beta-202922	1490	80	-5.2	-74.74	[105]
Beta-52136	1490	100	5.79	-67.53	[101]
IVIC-10008	1490	105	7.59	-66.38	[78]
OxA-34375	1491	29	5.6	-67.61	[24]
Beta-16648	1495	80	8.37	-70.51	[41]
Lyon-9521	1495	20	-1.59	-78.01	[110]
Beta-242441	1500	40	-3.22	-60.12	[79]
Beta-262405	1500	40	-0.1	-77.44	[31]
Beta-297121	1500	30	-3.19	-60.35	[81]
Beta-90306	1510	60	-2.21	-78.06	[74]
IVIC-8544	1515	80	7.77	-65.81	[40]
Beta-294094	1520	40	-8.85	-64.07	[152]
Beta-294193	1520	30	-2.46	-64.77	[90]
Beta-52134	1520	100	5.8	-67.5	[101]
OBDY-1269	1520	40	0	0	[22]
P-406	1525	58	-3.3	-60.63	[107]
Beta-294093	1530	30	-8.85	-64.07	[152]
Beta-330941	1530	30	-1.77	-56.5	[35]
Tx-1576	1530	50	7.7	-67.95	[111]
KIA-26020	1535	25	5.17	-52.67	[18]
Beta-143608	1550	40	-3.19	-60.34	[11]
Beta-294095	1550	30	-8.85	-64.07	[152]
Beta-323284	1550	30	-8.86	-64.06	[153]
Beta-330929	1550	30	-1.77	-56.5	[35]
Beta-420444	1550	30	-3.12	-58.55	[9]
GrN-19574	1550	70	1.37	-72.96	[33]
GX-6264	1550	170	7.59	-66.38	[78]
Beta-297129	1560	30	-1.3	-62.24	[94]

Beta-355557	1560	30	-9.94	-67.5	[156]
Beta-406673	1560	30	-3.52	-64.97	[3]
IVIC-8545	1560	80	7.77	-65.81	[40]
GrN-16970	1565	35	-0.59	-72.4	[68]
Ua-37263	1565	35	- 10.06	-67.62	[154]
POZ-32474	1570	30	0	0	[6]
Ua-37262	1570	35	- 10.06	-67.62	[154]
Beta-145483	1580	40	-3.28	-60.2	[79]
Beta-146220	1580	60	-1.1	-49.62	[12]
Beta-242442	1580	40	-3.22	-60.12	[79]
Beta-297130	1580	30	-1.3	-62.24	[94]
Beta-322893	1580	30	-1.85	-56.53	[10]
Beta-322897	1580	30	-1.85	-56.53	[10]
OBDY-1259	1580	40	0	0	[22]
Ua-37260	1585	30	- 10.06	-67.62	[154]
Beta-106438	1590	60	-3.1	-60.37	[32]
Beta-178908	1590	40	-3.1	-60.37	[112]
Beta-97344	1590	50	7.77	-65.81	[40]
UGAMS-4051	1600	25	0	0	[113]
Beta-178909	1610	90	-3.1	-60.37	[112]
Beta-406675	1610	30	-3.36	-64.67	[3]
GrN-19575	1615	30	1.37	-72.96	[33]
IVIC-1371	1615	50	7.77	-65.81	[40]
SI-1371	1615	20	7.77	-65.81	[114]
POZ-35848	1616	30	0	0	[6]
Beta-406674	1620	30	-3.36	-64.67	[3]
Beta-25392	1630	80	1.76	-67.01	[4]
GX-2617	1630	100	-11.3	-73.03	[58]
Poz-44824	1635	30	4.89	-52.31	[57]
Beta-21890	1640	70	-0.62	-72.39	[7]
Beta-297119	1640	30	-3.19	-60.35	[81]
GrN-19523	1640	45	1.37	-72.96	[33]
IVIC-8968	1645	80	7.84	-65.75	[8]
Beta-25394	1650	70	1.85	-67.03	[4]
Beta-410639	1650	30	-3.12	-58.55	[9]
Beta-89269	1650	120	-2.21	-78.06	[74]
KIA-36190	1650	30	0	0	[6]
OBDY-650	1650	40	0	0	[2]
SI-5086	1650	95	-2.5	-57.97	[87]
Beta-330923	1660	30	-1.77	-56.5	[35]
OxA-15502	1660	28	-3.19	-60.35	[52]
D-AMS-1177	1663	25	-5.38	-78.76	[115]
Beta-21894	1670	70	-0.62	-72.39	[68]
Beta-69591	1670	80	7.77	-65.81	[40]

KIA-36192	1680	30	0	0	[6]
Tx-1577	1680	70	7.7	-67.95	[111]
Lyon-7696	1685	45	0	0	[6]
Beta-1504	1690	55	-0.62	-72.39	[65]
Beta-22641	1690	90	5.6	-67.61	[55]
KIA-36186	1695	30	0	0	[6]
Beta-231419	1700	40	-1.42	-56.45	[38]
[unreported]	1710	50	-2.17	-56.1	[56]
Beta-260335	1710	40	-8.6	-63.81	[152]
Beta-294309	1710	30	-9.79	-66.9	[154]
Beta-297118	1710	30	-3.19	-60.35	[81]
POZ-30954	1710	30	0	0	[6]
UGAMS-4049	1710	25	0	0	[113]
Beta-322898	1720	30	-1.85	-56.53	[10]
Beta-330921	1720	30	-1.77	-56.5	[35]
Beta-69592	1720	60	7.77	-65.81	[40]
IVIC-9233	1720	80	7.77	-65.81	[8]
Beta-115903	1730	40	-1.01	-77.4	[31]
Beta-143611	1730	90	-3.19	-60.34	[11]
Beta-18454	1730	80	4.02	-67.43	[64]
Beta-256015	1730	40	-1.85	-56.53	[10]
N-3876	1730	80	-2.21	-78.06	[116]
Beta-143624	1740	30	-3.19	-60.34	[79]
Beta-297132	1740	30	-1.36	-62.12	[94]
N-2353	1740	65	-2.83	-58.2	[17]
N-2354	1740	65	-2.83	-58.2	[17]
QC-323	1740	100	7.87	-65.73	[8]
UGAMS-4048	1740	25	0	0	[113]
PN-8028	1745	115	-1.96	-56.73	[39]
Beta-242437	1750	40	-3.21	-60.18	[117]
Lyon-7839	1750	45	0	0	[6]
N-2352	1750	105	-2.83	-58.2	[17]
N-2354b	1750	105	-2.83	-58.2	[17]
D-AMS-1178	1751	26	-5.38	-78.76	[115]
POZ-30939	1755	30	0	0	[6]
[unreported]	1760	40	-2.17	-56.1	[56]
Ua-37261	1760	35	- 10.06	-67.62	[154]
IVIC-8969	1765	80	7.84	-65.75	[8]
Beta-231416	1770	40	-1.42	-56.45	[38]
Beta-232416	1770	40	-1.42	-56.45	[38]
POZ-30946	1770	30	0	0	[6]
ETH-31230	1775	45	0	0	[6]
Ua-37567	1775	35	-9.87	-67.53	[154]
KIA-36187	1780	30	0	0	[6]
N-3874	1780	75	-2.21	-78.06	[116]
POZ-30952	1780	30	0	0	[6]

OxA-29469	1783	25	-9.94	-67.5	[156]
Beta-280928	1790	60	-8.64	-63.63	[153]
Beta-320431	1790	30	-5.38	-78.76	[115]
Beta-90630	1790	60	-2.21	-78.06	[74]
IVIC-6008	1790	65	-2.78	-71.38	[42]
KIA-26024	1795	25	5.17	-52.67	[18]
Y-297	1795	80	8.69	-62.2	[73]
[unreported]	1800	50	8.15	-62.76	[114]
Beta-25395	1800	80	1.63	-66.95	[4]
Beta-283903	1800	40	-2.42	-54.75	[118]
Beta-90724	1800	80	-3.1	-60.37	[32]
ETH-46371	1800	30	0	0	[6]
IAN-113	1800	85	-0.62	-72.39	[65]
POZ-36923	1805	30	0	0	[6]
[unreported]	1810	90	-3.13	-58.46	[119]
Beta-294090	1810	40	-8.84	-64.02	[152]
Beta-1503	1815	105	-0.62	-72.39	[65]
[unreported]	1820	70	-1.96	-56.73	[120]
Beta-330928	1820	30	-1.77	-56.5	[35]
POZ-36922	1820	30	0	0	[6]
Ua-37256	1820	30	-9.87	-67.53	[154]
Beta-109179	1830	80	-3.1	-60.37	[32]
Beta-294310	1830	30	-9.79	-66.9	[154]
Beta-116472	1840	50	-2.21	-78.06	[74]
SI-2776	1840	90	-1.96	-56.73	[39]
Beta-232418	1850	70	-1.42	-56.45	[38]
Beta-288232	1850	40	-10.34	-67.65	[154]
Ua-37252	1855	30	-10.08	-67.57	[154]
N-313	1860	110	-8.27	-74.64	[53]
P-372	1864	58	-3.14	-58.43	[37]
Ua-37235	1865	65	-9.87	-67.53	[154]
Beta-128711	1870	40	-0.89	-77.26	[31]
Beta-232421	1870	40	-1.42	-56.45	[38]
N-4490	1870	89	-2.21	-78.06	[116]
ARC-710	1875	80	0	0	[22]
KIA-35514	1875	30	0	0	[6]
D-AMS-1175	1888	26	-5.38	-78.76	[115]
Beta-294085	1890	30	-8.87	-64.06	[152]
POZ-30953	1890	30	0	0	[6]
GrN-14994	1895	30	-0.66	-72.08	[7]
Beta-232414	1900	60	-1.42	-56.45	[38]
GrN-14997	1900	30	-0.66	-72.08	[7]
KIA-36188	1900	30	0	0	[6]
QC-0	1900	220	7.77	-65.81	[8]
QC-444E	1900	220	7.77	-65.81	[8]

Y-0	1900	50	8.66	-62.24	[108]
Ua-37251	1905	35	-10.08	-67.57	[154]
Beta-22015	1910	100	-2.55	-77.41	[48]
Beta-232415	1910	70	-1.42	-56.45	[38]
Beta-297126	1910	40	-4.33	-59.68	[81]
POZ-36926	1915	30	0	0	[6]
POZ-30950	1920	30	0	0	[6]
Beta-281108	1930	40	-1.77	-56.5	[35]
N-4489	1930	60	-2.21	-78.06	[116]
UGAMS-4050	1930	25	0	0	[113]
Beta-178920	1940	60	-3.23	-60.27	[79]
Beta-294092	1940	30	-8.84	-64.02	[152]
N-3872	1940	115	-2.21	-78.06	[116]
ARC-859	1955	70	0	0	[6]
[unreported]	1960	40	-2.17	-56.1	[56]
Beta-297133	1970	30	-3.58	-61.38	[59]
KIA-36191	1975	80	0	0	[6]
[unreported]	1980	60	-1.47	-56.41	[120]
Beta-143621	1980	80	-3.19	-60.34	[11]
ARC-860	1985	50	0	0	[6]
SI-687	1985	170	-0.46	-77.89	[62]
Beta-116471	1990	50	-2.21	-78.06	[74]
Beta-231422	1990	70	-1.42	-56.45	[38]
Beta-288233	1990	30	-10.34	-67.65	[154]
Beta-90307	1990	70	-2.21	-78.06	[74]
N-4492	1990	85	-2.21	-78.06	[116]
Beta-232420	2000	50	-1.42	-56.45	[38]
N/A-0	2000	30	-5.66	-78.65	[27]
POZ-30940	2000	30	0	0	[6]
POZ-30942	2000	30	0	0	[6]
SI-300	2000	90	-0.83	-75.53	[73]
Beta-18452	2010	180	4.01	-67.66	[64]
Beta-294079	2010	30	-8.84	-63.97	[152]
SI-2774	2015	95	-1.96	-56.73	[39]
Beta-190283	2020	60	-1.71	-56.41	[38]
SI-202	2020	280	-0.63	-49.54	[103]
Beta-109244	2030	60	6.08	-59.34	[84]
Beta-202675	2030	40	-3.1	-60.37	[79]
Beta-41946	2030	70	6.08	-59.34	[84]
IVIC-417	2030	70	8.37	-62.65	[49]
POZ-30852	2035	35	0	0	[6]
[unreported]	2040	40	-2.17	-56.1	[56]
Beta-248485	2040	40	-2.42	-54.75	[118]
L-0	2050	120	-3.2	-59.83	[121]
Ua-37264	2050	35	-9.96	-67.5	[154]

Lyon-7784	2055	45	0	0	[6]
[unreported]	2060	250	9.73	-70.44	[122]
Beta-18458	2060	130	3.98	-67.3	[64]
Beta-22741	2070	70	-8.83	-63.37	[21]
N-3871	2070	85	-2.21	-78.06	[116]
OBDY-653	2070	45	0	0	[2]
POZ-35843	2075	30	0	0	[6]
Beta-294098	2080	30	-8.86	-64.03	[152]
Beta-76246	2080	70	4.65	-58.68	[123]
[unreported]	2090	50	-2.17	-56.1	[56]
Beta-232424	2100	40	-1.42	-56.45	[38]
POZ-36924	2100	30	0	0	[6]
Beta-100309	2110	70	-2.21	-78.06	[74]
Beta-202677	2110	70	-3.1	-60.37	[79]
Ua-37253	2110	35	-10.08	-67.57	[154]
Beta-143622	2120	40	-3.19	-60.34	[11]
Beta-232423	2120	60	-1.42	-56.45	[38]
Beta-0	2130	140	-8.83	-63.37	[21]
Beta-420231	2130	30	-3.08	-58.57	[9]
SI-593	2140	120	-0.46	-77.89	[62]
POZ-30943	2145	30	0	0	[6]
D-AMS-1179	2148	29	-5.37	-78.75	[124]
Beta-27649	2150	70	7.52	-58.7	[84]
N-3873	2150	135	-2.21	-78.06	[116]
POZ-30947	2150	35	0	0	[6]
Hann-8028	2155	155	-1.96	-56.73	[39]
Beta-89267	2160	80	-2.21	-78.06	[74]
Beta-897267	2160	80	-2.21	-78.06	[74]
UGAMS-4052	2160	30	0	0	[113]
IVIC-120	2180	110	8.2	-70.08	{Tamers, 2016 #6893}
Beta-190282	2210	50	-1.71	-56.41	[38]
D-AMS-1183	2219	32	-5.37	-78.75	[124]
Beta-281110	2250	70	-1.77	-56.5	[35]
Beta-287171	2260	40	-4.83	-79.26	[23]
WK-16222	2269	42	-3.28	-60.2	[52]
Beta-320434	2270	30	-5.37	-78.75	[124]
WK-6834	2270	63	-2.43	-54.71	[19]
SI-4266	2275	65	-9.59	-65.37	[157]
Ua-37265	2275	35	-9.96	-67.5	[154]
Beta-178910	2280	100	-3.1	-60.37	[112]
Beta-188267	2280	40	-4.83	-79.26	[23]
GrN-846	2290	50	5.61	-55.14	[125]
GrN-19809	2300	65	1.37	-72.96	[33]
Beta-143597	2310	120	-3.28	-60.2	[11]

Beta-89270	2310	70	-2.21	-78.06	[74]
Beta-89720	2310	70	-2.21	-78.06	[74]
Beta-97528	2310	140	-3.1	-60.37	[32]
IVIC-9521	2320	100	8.25	-62.77	[30]
KIA-36135.2	2325	25	0	0	[6]
GrN-16666	2335	20	2.61	-72.83	[126]
Beta-33456	2340	90	-8.8	-63.95	[127]
OxA-29694	2344	30	-9.94	-67.5	[156]
Beta-106086	2360	60	-2.21	-78.06	[74]
[unreported]	2370	30	-2.42	-54.75	[118]
[unreported]	2370	30	-5.72	-78.79	[118]
GrN-19521	2370	90	1.37	-72.96	[33]
D-AMS-0	2394	25	-5.38	-78.76	[115]
Beta-321194	2400	40	-2.46	-64.77	[90]
GrN-4328	2400	75	-3.13	-59.94	[88]
Beta-22757	2410	50	-8.76	-63.43	[21]
Beta-294195	2410	40	-2.46	-64.77	[90]
D-AMS-1184	2413	28	-5.37	-78.75	[124]
D-AMS-1180	2422	31	-5.37	-78.75	[124]
LJ-4652	2430	40	-1	-75	[116]
OxA-29507	2432	25	-9.94	-67.5	[156]
Beta-320432	2440	30	-5.38	-78.76	[115]
Beta-320433	2440	30	-5.37	-78.75	[124]
IVIC-9522	2440	85	8.25	-62.77	[30]
[unreported]	2450	60	8.15	-62.76	[114]
Beta-294078	2450	30	-9.38	-64.36	[152]
Beta-320436	2470	30	-5.37	-78.75	[115]
OxA-29513	2487	25	-9.94	-67.5	[156]
Beta-22764	2500	90	4.57	-59.69	[127]
Beta-294194	2500	40	-2.46	-64.77	[90]
Beta-322899	2500	30	-1.85	-56.53	[10]
OxA-28208	2501	31	8.69	-62.2	[109]
OxA-28168	2514	24	8.69	-62.2	[109]
POZ-30960	2515	35	0	0	[6]
CEEA-162	2520	70	0.46	-77.64	[128]
GrN-19522	2520	45	1.37	-72.96	[33]
Y-0	2520	140	8.69	-62.2	[108]
LJ-4653	2530	80	-1	-75	[116]
SI-0	2530	70	-6.15	-61.79	[81]
SI-865	2540	70	8.69	-62.2	[109]
Beta-93358	2550	50	0.1	-67.35	[43]
OxA-28167	2570	25	8.69	-62.2	[109]
Y-44	2570	130	8.69	-62.2	[108]
Beta-271183	2580	40	-1.06	-77.58	[31]
SI-592	2600	100	-0.46	-77.89	[62]
Y-1543	2600	200	-8.27	-74.64	[53]

IVIC-9519	2605	85	7.84	-65.75	[67]
SI-686	2615	100	-0.46	-77.89	[62]
Y-1546	2620	100	-10.49	-74.82	[73]
Beta-27655	2640	60	-8.87	-63.31	[21]
Beta-145485	2650	40	-3.28	-60.2	[79]
QC-0	2650	80	7.81	-65.8	[8]
Beta-76247	2660	70	4.65	-58.68	[84]
Beta-96854	2660	70	4.65	-58.68	[129]
SI-6636	2660	45	8.19	-59.78	[84]
Beta-321192	2690	30	-2.46	-64.77	[90]
Gx-8990	2690	175	7.18	-66.85	[36]
OxA-29511	2694	26	-9.94	-67.5	[156]
Beta-383583	2700	30	-2.64	-64.6	[70]
Y-43	2700	130	8.69	-62.2	[108]
GrA-2664	2710	60	1.37	-72.96	[33]
Y-0	2710	130	8.69	-62.2	[108]
Beta-115901	2730	100	-1.02	-77.43	[31]
SI-3950	2730	75	-8.86	-64.06	[127]
Beta-6949	2740	70	-0.62	-72.39	[97]
N-3870	2750	150	-2.21	-78.06	[130]
IVIC-9450	2760	90	7.59	-66.38	[26]
OxA-34372	2767	29	5.6	-67.61	[24]
Beta-294084	2780	40	-8.87	-64.06	[152]
Beta-89271	2780	90	-2.21	-78.06	[74]
Y-0	2786	88	8.69	-62.2	[108]
[unreported]	2800	70	-1.47	-56.41	[120]
Beta-115902	2800	40	-1.01	-77.4	[31]
Y-294	2800	150	8.69	-62.2	[131]
QC-0	2805	130	7.81	-65.8	[8]
Y-316	2820	80	8.69	-62.2	[108]
Y-0	2850	120	8.69	-62.2	[108]
N-3869	2860	135	-2.21	-78.06	[130]
Y-0	2860	130	8.69	-62.2	[108]
IVIC-549	2870	150	7.96	-70.33	[132]
Y-0	2873	77	8.69	-62.2	[108]
Y-0	2880	130	8.69	-62.2	[108]
GX-6269	2890	145	7.59	-66.38	[78]
Beta-322219	2900	30	-2.43	-54.71	[83]
OxA-296465	2901	28	-9.94	-67.5	[156]
[unreported]	2910	135	-5.64	-78.53	[133]
Beta-76854	2910	80	4.65	-58.68	[84]
Beta-90722	2910	70	-3.1	-60.37	[32]
WK-6836	2912	56	-2.43	-54.71	[19]
Ua-37238	2915	35	-9.96	-67.5	[154]
Beta-181459	2930	150	-4.83	-79.26	[23]
Beta-190281	2930	50	-1.71	-56.41	[38]

SI-385	2930	200	-0.63	-49.54	[103]
Hann-7453	2950	130	-1.42	-56.45	[39]
I-8971	2970	85	7.8	-65.8	[8]
OxA-2535	2990	85	7.81	-65.8	[8]
Beta-283902	3000	40	-2.42	-54.75	[118]
OxA-2534	3000	85	7.81	-65.8	[8]
ARC-722	3020	50	0	0	[22]
GX-2135	3022	160	-12.54	-73.84	[58]
KIA-26019	3025	20	5.32	-52.87	[46]
Beta-109206	3050	50	-1.01	-77.42	[31]
N-4203	3050	85	-2.21	-78.06	[134]
Beta-322221	3060	30	-2.43	-54.71	[83]
OxA-28166	3080	25	8.69	-62.2	[109]
POZ-30961	3110	35	0	0	[6]
SI-0	3115	65	8.19	-59.78	[135]
Beta-210218	3140	40	-4.83	-79.26	[23]
Beta-27016	3140	70	-8.87	-63.31	[21]
Beta-294100	3140	40	-8.86	-64.03	[152]
CEEA-161	3140	70	0.46	-77.64	[128]
[unreported]	3150	350	5.78	-67.47	[40]
Beta-93362	3160	60	0.58	-67.5	[43]
Beta-323282	3170	30	-8.86	-64.06	[153]
SI-6635	3185	65	8.19	-59.78	[84]
P-993	3225	68	-10.49	-74.82	[53]
Beta-93360	3240	50	0.1	-67.35	[43]
Beta-322223	3260	30	-2.43	-54.71	[83]
Hann-7452	3280	45	-1.42	-56.45	[39]
[unreported]	3286	59	-2.07	-54.17	[20]
Beta-288234	3310	40	-10.34	-67.65	[154]
Beta-18457	3320	350	4.64	-67.78	[64]
Beta-321193	3320	30	-2.46	-64.77	[90]
IVIC-10742	3320	100	7.84	-65.75	[67]
SI-6637	3350	50	8.19	-59.78	[84]
P-990	3368	77	-10.49	-74.82	[53]
SI-0	3385	85	8.19	-59.78	[135]
SI-6640	3385	60	8.19	-59.78	[135]
[unreported]	3390	140	-2.07	-54.17	[20]
Beta-377103	3390	30	-9.87	-67.53	[156]
SI-6639	3390	55	8.19	-59.78	[135]
Y-455	3400	120	10.78	-68.36	[131]
[unreported]	3410	40	-2.07	-54.17	[20]
Gx-8987	3425	195	6.25	-67.48	[36]
Beta-287172	3430	40	-4.83	-79.26	[23]
Beta-252621	3440	40	6.31	-67.22	[136]

SI-685	3445	140	-0.46	-77.89	[62]
Beta-324360	3460	30	-1.85	-78.06	[82]
Beta-210217	3480	70	-4.83	-79.26	[116]
[unreported]	3488	64	-2.07	-54.17	[20]
[unreported]	3500	90	10	-62.2	[114]
GrN-16668	3500	80	2.61	-72.83	[126]
[unreported]	3510	90	-2.07	-54.17	[20]
POZ-30951	3525	30	0	0	[6]
Beta-261411	3530	40	-4.83	-79.26	[23]
Beta-2007	3550	65	8.19	-59.78	[135]
[unreported]	3563	68	-2.07	-54.17	[20]
[unreported]	3563	57	-2.07	-54.17	[20]
Beta-287175	3570	40	-4.83	-79.26	[23]
Beta-287173	3580	40	-4.83	-79.26	[23]
P-992	3587	95	-10.49	-74.82	[53]
Beta-261410	3600	40	-4.83	-79.26	[23]
[unreported]	3620	50	7.96	-70.33	[104]
Beta-261409	3620	40	-4.83	-79.26	[23]
Beta-261412	3630	40	-4.83	-79.26	[23]
Beta-188264	3660	90	-4.83	-79.26	[23]
GrN-16667	3660	35	2.61	-72.83	[126]
IVIC-9232	3665	85	7.84	-65.75	[8]
Beta-52538	3670	450	-3.25	-78.69	[15]
UBA-20797	3671	32	-1.85	-78.06	[82]
ARC-718	3680	150	0	0	[6]
Beta-188266	3690	40	-4.83	-79.26	[23]
Beta-355558	3690	30	-9.94	-67.5	[156]
KIA-27630	3690	25	5.32	-52.87	[137]
SI-0	3690	90	8.19	-59.78	[135]
Beta-197176	3700	40	-4.83	-79.26	[23]
Beta-214742	3700	60	-4.83	-79.26	[23]
Beta-261408	3700	40	-4.83	-79.26	[23]
Beta-161402	3710	40	-4.83	-79.26	[23]
Beta-161403	3710	40	-4.83	-79.26	[23]
IVIC-8546	3710	85	7.84	-65.75	[40]
[unreported]	3725	57	-2.07	-54.17	[20]
OxA-29509	3728	27	-9.94	-67.5	[156]
P-991	3728	65	-10.49	-74.82	[53]
Beta-30746	3750	110	-0.42	-51.91	[138]
Beta-210219	3790	160	-4.83	-79.26	[23]
Beta-261413	3810	40	-4.83	-79.26	[23]
Beta-188263	3820	40	-4.83	-79.26	[23]
Beta-261400	3820	40	-4.83	-79.26	[23]
Beta-188265	3830	70	-4.83	-79.26	[23]
POZ-30949	3840	35	0	0	[6]

POZ-30956	3840	35	0	0	[6]
Beta-27019	3850	70	-8.87	-63.31	[21 3961]
Gif-1536	3850	110	-5.43	-78.48	[139]
Beta-172587	3860	40	-4.83	-79.26	[23]
[unreported]	3950	180	3.88	-60.9	[89]
SI-6638	3975	45	8.19	-59.78	[84]
GX-5180	3980	150	7.59	-66.38	[78]
GX-30043	3990	70	-4.83	-79.26	[23]
Ua-37237	3990	40	-9.96	-67.5	[154]
GX-30044	4000	71	-4.83	-79.26	[23]
I-9159	4000	100	-2.53	-77.19	[48]
Beta-32187	4020	80	8.21	-59.8	[140]
Beta-179721	4030	40	-3.25	-78.69	[15]
Beta-330927	4040	30	-1.77	-56.5	[35]
Beta-330925	4050	30	-1.77	-56.5	[35]
IVIC-8548	4065	85	7.84	-65.75	[40]
Beta-330926	4080	30	-1.77	-56.5	[35]
IVIC-8970	4090	105	7.84	-65.75	[40]
SI-4332	4115	50	8.21	-60.92	[123]
SI-4334	4115	50	8.21	-60.92	[141]
Beta-27406	4130	160	-8.87	-63.31	[127]
KIA-33565	4135	25	0	0	[6]
ISGS-385	4155	75	-2.53	-77.19	[82]
Beta-232413	4180	70	-1.42	-56.45	[38]
SI-7020	4215	70	7.32	-58.66	[84]
Beta-197175	4300	40	-4.83	-79.26	[23]
GrN-13733	4330	45	-0.59	-72.4	[68]
POZ-30959	4340	35	0	0	[6]
OxA-29468	4350	50	-9.94	-67.5	[156]
KIA-26023	4435	35	4.56	-52.21	[92]
Beta-312078	4450	30	-4.83	-79.26	[23]
ARC-1058	4465	50	0	0	[6]
Beta-294080	4470	40	-8.84	-63.97	[152]
N-4201	4470	35	-2.21	-78.06	[142]
POZ-30955	4470	35	0	0	[6]
KIA-33566	4480	25	0	0	[6]
Beta-202679	4500	40	-3.21	-60.18	[117]
KIA-35513	4520	30	0	0	[6]
SI-5742	4525	75	8.21	-60.92	[135]
[unreported]	4600	70	10.47	-63.76	[114]
GrN-14987	4645	40	-0.59	-72.4	[68]
GrN-2668	4700	60	1.37	-72.96	[33]
N-4491	4700	70	-2.21	-78.06	[142]
Beta-27021	4780	70	-8.87	-63.31	[127]
OxA-2532	4790	90	7.84	-65.75	[8]
[unreported]	4807	90	-8.83	-63.37	[21]

SI-7019	4890	75	7.32	-58.66	[84]
Beta-260333	4910	100	-8.6	-63.81	[152]
SI-863	4930	105	8.69	-62.2	[109]
KIA-36135.1	5030	130	0	0	[6]
POZ-42516	5030	35	0	0	[16]
SI-5741	5065	70	8.21	-60.92	[135]
ETH-31229	5125	50	5.32	-52.87	[46]
SI-4274	5155	85	-3.03	-60.19	[81]
Y-853	5190	120	10.78	-68.36	[131]
Beta-27017	5210	70	-8.83	-63.37	[21]
KIA-31229	5215	50	5.32	-52.87	[137]
OxA-29506	5230	29	-9.94	-67.5	[156]
Beta-178913	5240	40	-3.21	-60.18	[112]
Beta-51590	5250	30	7.43	-58.68	[84]
Beta-57590	5250	130	7.43	-58.68	[84]
N/A-0	5290	60	8.15	-62.88	[114]
Beta-377102	5300	30	-9.87	-67.53	[156]
Col-841	5320	70	0.74	-72.74	[33]
GrA-18724	5320	70	0.74	-72.74	[33]
Beta-32188	5340	100	7.32	-58.66	[84]
GX-5181	5425	195	7.59	-66.38	[78]
SI-5743	5460	65	8.21	-60.92	[135]
Y-852	5500	100	10.78	-68.36	[131]
ETH--49960	5540	30	0	0	[6]
Eth-31228	5550	55	5.32	-52.87	[137]
Beta-202680	5560	40	-3.21	-60.18	[117]
Col-798	5560	70	0.74	-72.74	[33]
GrN-19707	5560	70	0.74	-72.74	[33]
Y-854	5580	160	10.78	-68.36	[131]
POZ-36003	5650	40	0	0	[6]
IVIC-10009	5680	165	7.59	-66.38	[78]
GX-12844	5705	80	-2.55	-54.34	[143]
Beta-27256	5710	80	7.58	-59.32	[84]
OxA-29467	5731	32	-9.94	-67.5	[156]
Beta-377101	5760	30	-9.87	-67.53	[156]
SI-866	5925	95	8.69	-62.2	[109]
SI-4333	5965	50	8.21	-60.92	[141]
KIA-33567	6020	30	0	0	[6]
Beta-294088	6050	40	-8.6	-63.81	[152]
Beta-294089	6050	40	-8.6	-63.81	[152]
Beta-2758	6090	130	-8.83	-63.37	[21]
Beta-27658	6090	130	-8.87	-63.31	[21]
KIA-26155	6096	30	5.45	-53.77	[144]
Beta-255794	6140	40	-0.42	-51.9	[44]
KIA-26153	6181	27	5.45	-53.77	[144]
ETH-30438	6190	60	0	0	[6]

KIA-27194	6190	30	0	0	[6]
Y-41	6200	380	8.69	-62.2	[108]
KIA-26154	6201	30	5.45	-53.77	[144]
OxA-1540	6300	90	-2.55	-54.34	[143]
Beta-264970	6340	50	8.11	-59.57	[84]
OxA-2431	6590	80	-2.55	-54.34	[143]
OxA-2432	6640	80	-2.55	-54.34	[143]
GIF-7200	6660	80	0	0	[6]
Beta-252622	6840	40	6.31	-67.22	[136]
Beta-90721	6850	100	-3.1	-60.37	[32]
OxA-1541	6860	100	-2.55	-54.34	[143]
OxA-1760	6880	80	-2.55	-54.34	[143]
SI-5075	6885	85	8.21	-60.92	[123]
OxA-1543	6930	80	-2.55	-54.34	[145]
Beta-27013	6970	60	-8.87	-63.31	[21]
OxA-1544	6980	80	-2.55	-54.34	[143]
OxA-29508	6984	33	-9.94	-67.5	[156]
OxA-1545	7000	80	-2.55	-54.34	[145]
[unreported]	7010	190	5.79	-67.53	[146]
OxA-1542	7010	90	-2.55	-54.34	[145]
OxA-1547	7080	80	-2.55	-54.34	[143]
OxA-1546	7090	80	-2.55	-54.34	[143]
Beta-252623	7130	50	6.31	-67.22	[136]
IVIC-888	7180	80	10.13	-61.55	[147]
Beta-232417	7230	50	-1.42	-56.45	[38]
GrN-16669	7250	10	2.61	-72.83	[126]
Beta-27055	7280	100	7.43	-58.61	[84]
SI-4277	7320	100	-4.18	-59.31	[81]
Beta-242435	7500	50	-3.21	-60.18	[117]
Beta-178911	7650	40	-3.21	-60.18	[112]
Beta-178912	7700	50	-3.21	-60.18	[112]
Beta-260334	7740	50	-8.6	-63.81	[152]
Beta-260331	7760	50	-8.81	-63.95	[152]
Beta-322220	7760	40	-2.43	-54.71	[83]
Beta-252624	7840	50	6.31	-67.22	[136]
UCR-3419	8090	60	-0.66	-72.08	[14]
Beta-322222	8110	50	-2.43	-54.71	[83]
Beta-294081	8120	50	-8.84	-63.97	[152]
Beta-_NC	8140	80	-2.18	-56.1	[63]
GrN-19515	8150	40	0.74	-72.74	[33]
Beta-361090	8210	40	-0.66	-72.08	[7]
IVIC-10740	8210	190	7.84	-65.75	[67]
Beta-27015	8230	100	-8.87	-63.31	[21]
Beta-361092	8460	40	-0.66	-72.08	[7]
Beta-64601	8510	110	-0.66	-72.08	[14]
Beta-361093	8710	40	-0.66	-72.08	[7]

Beta-64602	8710	110	-0.66	-72.08	[148]
Beta-332854	8720	40	-0.66	-72.08	[7]
Beta-332852	8730	50	-0.66	-72.08	[7]
Beta-294102	8740	50	-8.86	-64.03	[152]
Beta-332853	8800	40	-0.66	-72.08	[7]
Beta-115898	8810	60	-1.02	-77.43	[31]
Beta-22638	9020	100	5.7	-67.63	[149]
GX-17395	9125	250	-0.66	-72.08	[14]
Beta-52963	9160	90	-0.66	-72.08	[14]
[unreported]	9210	120	5.7	-67.63	[146]
Beta-252625	9250	60	6.31	-67.22	[136]
Beta-52964	9250	140	-0.66	-72.08	[14]
Beta-202678	9460	50	-3.21	-60.18	[117]
POZ-44836	9590	50	0	0	[16]
Beta-115899	9850	60	-1.02	-77.43	[31]
GX-19523	10000	60	-2.07	-54.17	[20]
GX-0	10110	60	-2.07	-54.17	[20]
GX-19532	10110	60	-2.07	-54.17	[150]
GX-19528	10120	70	-2.07	-54.17	[20]
GX-0	10180	60	-2.07	-54.17	[20]
GX-19534	10190	50	-2.07	-54.17	[20]
Beta-76955	10210	60	-2.07	-54.17	[150]
GX-0	10210	70	-2.07	-54.17	[20]
GX-0	10210	60	-2.07	-54.17	[20]
GX-19530	10210	60	-2.07	-54.17	[150]
Beta-75001	10230	60	-2.07	-54.17	[20]
GX-0	10250	70	-2.07	-54.17	[20]
Beta-75002	10260	60	-2.07	-54.17	[150]
GX-0	10260	70	-2.07	-54.17	[20]
NZA-9897	10261	62	-2.07	-54.17	[20]
GX-17421	10275	275	-2.07	-54.17	[20]
Beta-75008	10280	70	-2.07	-54.17	[20]
Beta-75007	10290	80	-2.07	-54.17	[20]
GX-19527	10290	70	-2.07	-54.17	[20]
Beta-75004	10300	60	-2.07	-54.17	[20]
GX-17422	10305	275	-2.07	-54.17	[20]
GX-19535	10310	70	-2.07	-54.17	[20]
Beta-75006	10320	70	-2.07	-54.17	[20]
Beta-75009	10330	60	-2.07	-54.17	[20]
GX-0	10330	70	-2.07	-54.17	[20]
GX-19536	10350	70	-2.07	-54.17	[20]
Beta-76954	10360	50	-2.07	-54.17	[20]
GX-19533	10360	60	-2.07	-54.17	[20]
GX-0	10370	60	-2.07	-54.17	[20]
GX-19525	10370	70	-2.07	-54.17	[20]
GX-19531	10370	60	-2.07	-54.17	[150]

GX-0	10380	60	-2.07	-54.17	[20]
Beta-75003	10390	70	-2.07	-54.17	[20]
GX-19540	10390	60	-2.07	-54.17	[20]
GX-17400	10392	78	-2.07	-54.17	[20]
GX-19538	10410	60	-2.07	-54.17	[20]
GX-19529	10420	70	-2.07	-54.17	[20]
Beta-75005	10450	60	-2.07	-54.17	[150]
Beta-76952	10450	60	-2.07	-54.17	[20]
GX-19537	10470	70	-2.07	-54.17	[20]
GX-19539	10470	70	-2.07	-54.17	[150]
GX-0	10480	70	-2.07	-54.17	[20]
GX-19526	10480	70	-2.07	-54.17	[150]
GX-19541	10490	80	-2.07	-54.17	[20]
GX-0	10510	60	-2.07	-54.17	[20]
GX-19524	10510	60	-2.07	-54.17	[150]
Beta-76953	10560	60	-2.07	-54.17	[20]
GX-0	10570	70	-2.07	-54.17	[20]
GX-17420	10655	285	-2.07	-54.17	[20]
NZA-9898	10683	80	-2.07	-54.17	[20]
Beta-95602	10710	60	9.55	-69.96	[151]
GX-17414	10875	295	-2.07	-54.17	[20]
GX-17407	10905	295	-2.07	-54.17	[20]
GX-17406	11110	310	-2.07	-54.17	[20]
GX-17413	11145	135	-2.07	-54.17	[20]
Gx-8994	11210	425	7.65	-66.18	[36]
POZ-42514	13290	60	0	0	[16]

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